ISOLA BELLA LAGO MAGGIORE, ITALY

G Baxter

SUMMER.

BY

ROBERT MUDIE

AUTHOR OF THE HEAVENS THE EARTH, THE AIR, THE SEA

&c. &c. &c.

SUMMER FLY.

LONDON.

THOMAS WARD & CO. PATERNOSTER ROW

MDCCCXXXVII.

SUMMER;

OR,

THE CAUSES, APPEARANCES,

AND EFFECTS

OF

THE GRAND NUPTIALS OF NATURE,

IN ALL ITS DEPARTMENTS.

BY R. MUDIE,

AUTHOR OF "THE HEAVENS," "THE EARTH," ETC.

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PREFACE.

If, as is sometimes fondly hoped, there be in a Preface any virtue that can win the attention of the reluctant, or sweeten the acerbity of the critical reader, seldom has a book stood more in need of it than the volume now, with much deference, and gratitude for the past, submitted to the public. One cause of this is general,—applying more or less to every author and every subject; for, while the thoughts of the author are concentrated upon a single volume, the reader may make himself master of twenty; and thus, a man who devotes his days and his nights to the most anxious execution of a desire to instruct the public, has the constant fear, and, not unfrequently, the humbling conviction that, especially when they are running the career of knowledge so rapidly and so profitably as at the present time, the public are leaving him behind in his ignorance. Still there is one consolation: new readers are growing up every day; and he who can but win their apt and willing ear, may find consolation in his labours, even when he feels that he is distanced by the seniors.

The principal cause, however, is in the subject of this volume. Summer is too ample to be grasped, and too fascinating to be understood. Its beauty, its melody, and its perfume, lead the senses captive, while the mind is held in the chains of admiration. Therefore, although Summer is really one of the most fertile and inviting of subjects, it is one of the most difficult, especially for a writer who is restricted to one small volume. He cannot trust himself with the breadth of detail, the full and fair development of any one of the countless subjects which muster their array around him, each one more inviting than another; for if he did, his work on Summer would become nothing but one unbroken expatiation upon some single character or production of this most instructive, but most enchanting season.

I have felt the effects of this exquisite gratification in many a delightful ramble during the sunny months, from which I have returned highly gratified, and much invigorated certainly, but with an increase of knowledge wofully scanty, as compared with what I had anticipated before setting out. Schooled in this manner by my own personal experience, I have, in the following pages, endeavoured to avoid the fascinations of Summer, except a little touch here and there, to wile to the observation of Summer nature such readers as may not have had a taste of that sweetest of all earthly enjoyments. If I had pursued an opposite course, my labour would have been far more easy, and probably more pleasant; for, to one who has been much by field or flood in the Summer, with open eyes, a volume of mere description would be as easy as pouring water out of a vessel, aye, or as lolling in the shade of a fragrant birch by a mountain stream, and seeing the water leaping in living diamonds over the rock.

All this, however, any body can see, and may do; and, as a man has no business to write a book, unless he has at least the belief that he is telling somebody something that they might not have arrived at without his assistance, I have pursued a different plan. I have endeavoured, in as plain language as I could, to point out in what Summer consists, what are the causes which produce it, what the action is that it especially performs, and how our globe, in its two constituent surfaces of land and water, and the circumambient air, and their inhabitants, are prepared for the action of this season. This I have endeavoured to do, with reference both to wild nature and to man, in order to show, that while man makes himself acquainted with the properties and the working of all around him, he should at the same time see the relation in which he himself stands, and the duties which, in consequence of that relation, he is called upon to perform, and the neglect of which in him is both crime and punishment.

The reason which has been stated is not the only one that induced me to take this general view of the Summer, instead of culling out such portions of the details as would have afforded the greatest scope for description, and have given to that description a certain interest in the borrowed lustre of their own brightness, in whatever style they had been attempted. The general relations—something that will connect scene with scene and object with object, so as to make them reciprocally reflections of each other, and each one, in so far, an artificial memory to the rest, is unquestionably that which is of most value to the public. When one is in possession of the connecting principle from the beginning, every single observation can be turned to account whenever it is made; and every one can make the observations for himself; but no man can, of himself, arrive at the general principles, unless he has made a long series of observations, in the making of which he is really objectless; and thus the observations themselves are seldom accurate, and never make any strong or lasting impression.

Here, again, I feel, though regret is inseparable from the feeling, that I am borne out by my own experience; for if, when beginning to notice things around me, I had had but a glimpse of the conclusions to which continued observation has led me, I feel that both the acquiring and the application of knowledge would have been easy matters. For useful exercise of the mind, as well as for useful labour with the hands, we want producing tools, not finished productions; and it is to be regretted that very many of the works which profess to instruct us, give us the production and not the tool. On all subjects connected with nature,—and if we follow it out till it become knowledge worthy of a rational being, every subject is so connected,—this is in an especial manner the case; and thus, though the works may set forth the erudition of their authors in the most favourable light, they set before the reader, often in the most masterly style, every thing—except what he especially wants. It would be too much in me to say, that I have *done* the opposite of this; but certainly I have *tried*.

In choosing subjects for illustration, especially where some breadth became necessary, I have in general preferred those that are least open to common observation. For instance, in treating both of preparations and of productions, I have devoted more to the sea than to the land; and I have passed lightly, or altogether omitted, those matters which the majority of people have before their eyes every day; being well convinced that they who stubbornly neglect nature itself, have small chance of being aroused by any written description. I have entered into few details that can burden the memory, and I have studiously avoided technicality and hypotheses; so that I may perhaps be excused if I solicit a perusal of the whole book, before the reader comes to a final decision on any one part of it.

ROBERT MUDIE.

Grove Cottage, Chelsea,
May 15, 1837.

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As it would have been impossible to find any subject emblematical of the whole Summer, a scene in Italy has been chosen, which shows both land and water under a sunny sky. The Butterfly is also characteristic; and the greatest attention has been paid to the execution, which will be found very superior.

SUMMER.

CHAPTER I.

GENERAL PRINCIPLES, ILLUSTRATIONS, AND REMARKS.

SUMMER is the bloom of the year,—the period during which all the growing and living children of nature, which wax and wane with the revolving seasons, are in the spring-tide of their activity, and when all those general agencies by which they are stimulated are working to the very top of their bent. Summer is, therefore, the period of the year at which the study of nature is most inviting and instructive; and it is especially the period during which the young, or those adults who have hitherto neglected this grand and never-failing source of instruction and pleasure, can approach it with the greatest certainty and success.

In early spring and late autumn, and even in the settled quiescence of winter, when all is shrouded up in uniform and unbroken snow, there are lessons of the most spirit-stirring character,—lessons which probably lift the contemplation higher into the sublime, lead it deeper to the profound, and send it to career farther and more fleetly over the interminable field of created wonders than any which arise from the flowery, fragrant, and active display of the Summer. This is true to the analogy which links us, in so far as we are material, to the rest of material nature, leads us to the study of that nature, and guides us, by easy and willing steps, to the Great Author of nature, and makes us feel that "we also are his offspring." For there is a keen perception and enjoyment of the senses, in early youth, the causes of which are unknown to us, and which abate even at that stage of our existence which may be considered as the summer of life. There are also, as the winter of age begins to strip us of blossom and leaf, and to whiten us with the snows of time, feelings which temper the mind for immortality, thoughts which raise us higher, and carry us farther, than any which arise where the bloom of our life is vying with that of the year. But still lofty and wide-ranging as these thoughts are, they are not the ones to which the immediate passage from boyhood would be the most natural or the most agreeable. The proverb says, that "we cannot put old heads upon young shoulders;" and though the common understanding of the proverb is usually restricted to the same moment of time, it applies to all time; and the putting on of the "old head" before corresponding age had ripened the shoulders for its reception, would be just as incongruous, and as destructive of the flowers and the fruit—the beauty and the usefulness of the human character—even if possible, as the putting of winter upon the shoulders of spring would be destructive of the beauty and bounty of the year. In the one case as in the other, each season must have its appointed time ; and if we attempt to force beyond what nature allows, we frustrate. It is said of the male population of even places where the custom is to employ young boys in the pursuits to which men do not betake themselves until middle life or after it, that they are " never men," but pass from the imbecility of infant life to that of dotage,—have the spring and the winter of their sojourn upon earth, but little or none of the summer or the autumn.

It is matter of very general observation, that those who evince great precocity in early youth, fall into neglect, and merited neglect of course, when they come to manhood. There have been some exceptions to this, no doubt, but they have been so few as hardly to narrow the rule; and, if we were in possession of all the circumstances, there is no doubt that we would be able to explain each case on its own merits. This precocity is constitutional, in some instances ; and in these the falling-off is a premature old age. Others are the result of education, or of what is called *self*-education, which is a misnomer, for other than self-education there is none, though there may be the counterfeit. If we will attempt to force the proper action of Summer in the Spring, we must have an artificial protection throughout; and, whether the object of our culture be man or plant, or any thing else, this treatment takes it out of nature, and it is both frail and costly—impracticable as a general system, and worthless if it could be practised.

Summer is, both in the literal and the metaphorical sense, the season of blossoms; and as the blossoms make the fruit, the time of them is really the most important of the whole. In our middle latitudes, there is a very beautiful instance of design and adaptation in this. The grand stimulating agent in all terrestrial action, at least in a natural view of it on the surface of the earth, and the intensity of this action, is made up of two elements,—the portion of the twenty-four hours during which the sun is above the horizon, and the altitude of the sun above that horizon. Both of these, in either hemisphere, increase as the sun declines toward that hemisphere, or rather as the hemisphere inclines to the sun; though, as the first of these is the apparent result of the second as a reality, our using the one expression or the other does not affect the result. The increase or decrease of altitude is the same, with the same change of declination, in all latitudes; but the variation in time above the horizon increases with the latitude: consequently the higher the latitude the greater the change of solar action with the same change in declination. The change in declination increases from the solstice to the equinox, and diminishes from the equinox to the solstice. Thus the increase of solar action begins to slacken at the vernal equinox in March, and gradually diminishes till it becomes 0 at Midsummer; after this the decrease commences. This, however, only in so far as depends on the altitude of the sun; for the other element, the time which the sun is above the horizon, goes on increasing till the longest day, or day of the solstice.

Thus, in the advanced part of the Summer, there is a diminished increase of the momentary intensity of the solar action, and a lengthening of its daily duration. What is given to the presence of the sun above the horizon, is taken from the absence below it; and thus, as the Summer advances towards the longest day, all that works by the action of the sun works with less increase of intensity and for a longer time. After the longest day is past, both elements of the solar action diminish, slowly at first, and more rapidly afterwards, until the Summer merges in the autumn. Near the equator the changes are comparatively small, and they increase with the latitude; and the differences in this respect are what may be called the celestial differences of the character of Summer in different latitudes; but terrestrial causes modify these so much that the practical results as observed are very different from what the celestial theory would give.

Still, any one who thinks but for a moment will not fail to discern how beautifully the season of bloom is secured from violent action, either the one way or the other. This is enough to convince us that the action which goes on in the production of nature during the Summer is really the most important of the whole year; for it is performed with the maximum of power in the agents, and the minimum of disturbance in their operation. That resistance of winter, which but too often shrivels the young leaf and blights the early blossom in the spring, is vanquished, and completely staid from making any inroad, till the seasonal purposes of nature are accomplished; and the ardour of the stimulating causes which have vanquished this destructive one, are slackened, so that they may not injure that which, during the struggle of the early part of the year, they have preserved.

All this, too, is accomplished by means so very simple, that their simplicity proves the most wonderful part of the whole; for it is nothing more than the planes of the annual and daily motions of the earth intersecting each other at an angle of about 23° 28′; and the line of intersection passing through the equinoctial points of the annual orbit. We shall be better able to explain and appreciate the actual results in a future chapter; but as this principle is perfectly general, it is desirable that we should carry it along with us.

The application as to the human race is as apparent here as in the former cases. For if the laws of nature have been so framed by the Lawgiver as to place the Summer of the year in the situation of greatest safety in the year's revolution; so ought the Summer of the life of man to be placed in the situation of greatest safety, among the stages of his appointed time on the earth. Nature does this, in the case of all the irrational animals which belong wholly to material nature, and are of course in complete obedience to material laws. In so far, too, as man is under the laws of material nature, he is under their protection. But man, even considered as body, or animal, is not wholly under the protection of these laws; for, from the moment that the mind has acquired the requisite degree of experience, which prompts him to the exercise of his young judgment, he begins to exercise it, and this takes place long before he is able to regulate himself, even in what those who have had larger experience consider very simple cases. Man thus requires attentions and directions which the young of no other animal wants; and the more advanced and civilized the state of society in which man is born, the more does he stand in need of those attentions. This is not only true in principle, for it is also confirmed by the facts, whether we consider the relative civilization of different nations, or that of different ranks and classes in the same nation. The children of rude and savage tribes live, thrive, and grow up to maturity, under circumstances which would be fatal to children in civilized society; and among the latter, the child of the half-clad and homeless wanderer can endure far more than the child of those who possess and enjoy the comforts of life. It is true, perhaps, that, among savage nations, and the ignorant and degraded of other nations, a greater proportion of the children die in early infancy —though even this is not established with absolute certainty. But if it were, it would not affect the general principle, which is, that man being an intellectual as well as a material creature, and deriving no primary assistance from the laws of material nature in the intellectual part of his system, never can be wholly viewed as a mere animal.

But, the nearer the approach which his condition makes to that of the mere animal, the more must he be supported by the merely animal laws; for the operation of these laws, in the development, growth, and proportions of the human body, is as completely of itself, and as totally independent of any change, purpose, or care on the part of man, as the growth of a plant or animal, the fall of a rain-drop, or the motion of the earth in its orbit. This portion of his compound nature will, therefore, develop itself, unless it is prevented by some cause, external of the principles of its own working; and this cause may be either a malconformation, the origin of which is too early for our observation, or it may be a contingency arising from external nature, from the party who suffers it, or from those among whom that party is placed.

In a general point of view, therefore, the human body requires no training or educating to forward its own development; but, on the other hand, it may be injured, and seriously injured, by attempts of this kind. [For a few remarks on this subject, see the beginning of the sixth chapter of our volume on Spring.] It is true that the action of the body may be trained to the performance of any one kind of bodily labour more than to any other kind; and that this training gives a character to the body, so strong and so confirmed by long practice, that a person of even very moderate powers of observation, can readily tell the bodily occupation from the gait. A dancing master cannot walk steadily, but shuffles along, and the reason is that, in the practice of his trade, he cultivates the toes at the expense of the heels. In like manner, a sailor rolls along like a boat rocking on the ripple of the water; and the reason is that, for stability in a rolling ship, "getting his sea feet," as it is called, he must accommodate himself to a different centre of gravity from that of his own body. There is often a curious effect of this in a landsman, who has been one trip to sea, and moderately well rocked on the billows in the course of it. When he lands and takes his way along the streets, the buildings seem under the influence of something like an earthquake, violent in proportion to the observer's previous rocking at sea, but of course not attended with the slightest disaster. Still it is not very pleasant, to feel that the houses are nodding to you as you pass along. It is all fancy, no doubt, or rather the transfer of your own rocking to the houses; but if a fancy is as strongly felt, it has precisely the same effect as if it were a reality.

In cultivating and training the intellectnal part of man for its work, the powers and agencies of physical nature can really do nothing,—the whole must be obtained by the experience of the individual, or that of others, communicated, as one man communicates with another, by external signs or sounds as the mere instruments, bnt between mind and mind in the reality. In proportion as this kind of knowledge,—which material nature cannot *begin* to give, though it may be the means of much increase after a beginning has been made,—predominates over the other part, the individnal is taken from under the guidance and protection of the material laws and agencies, and becomes less an animal, and more a man, in the best and proper sense of the term.

This is abundantly proved by the fact that, if there are no human instructors by words, and especially by the far more forcible language of example, one generation does not improve a single jot upon another, but the race remain in the same state of utter stagnation, age after age and century after century. That nature around cannot, in its immediate productions and phenomena, as they pass before the momentary cognizance of the senses, be of the smallest use in causing this state of things, is fully established by the observed facts; which all tend to show, that even the most beautiful and productive land on the face of the earth, is quite incapable of giving even an impulse to its inhabitants, which can cause them to begin the business of civilization.

There seems, however, to be a power of teaching by experience, in the *succession* of the phenomena and productions of nature, though there is little or none in them taken singly, or in their momentary aspects; for, when we have repeatedly seen the same kind of changes follow each other, and the same succession, this suggests to us that there is a law of succession, or of cause and effect; and although, at the outset, we may be in ignorance or in error respecting this law, the simple feeling that such a law exists, is a beginning. In confirmation of this, we find that the places where civilization has begun have always been those in which there is a marked variation in the seasons; while in the lands of uniform Summer, even if that Summer is the most beautiful and abundant, the native population have remained stagnant. The population of the oriental archipelago, or islands immediately to the south-east of Asia, may, as they are described by modern voyagers and travellers, be accounted a contradiction of this; for though many of them are cruel in their dispositions, yet they are by no means without civilization, and they have made considerable progress in the arts, and in commerce. But these are not the aboriginal population; they are races which have come from other lands, and brought their arts and their other improvements with them; and wherever the aborigines (the Oceanic negroes) are found, they are in the fastnesses of the inland forests; and in their modes of life not very much, though of course a little, superior to the apes with which they are near neighbours in the forest. The fact of their remaining thus, amid the very abundance of nature's physical bounty, is sufficient proof that no mental improvement which shall grow with successive generations, can originate in the momentary seeing of the phenomena and productions of material nature, even where these always wear that very aspect which we suppose, and feel as well as suppose, to have the most stimulating influence upon all who come to the study of it with due, and indeed very moderate preparation.

These considerations involve many of the true principles upon which the intellectual part of man should be trained, whether the learning is more his own act, or that of others, who assume the duty, or who are appointed for the performance of it. To use a homely, but by no means an unappropriate simile, the powers and aptitudes of the party to be taught, bear a very strong resemblance to those powers or aptitudes in the animal and vegetable bodies, which render them fit for obeying the mere general impulse of nature, which brings them from the stagnation of winter, through the struggle of the spring to the beauty of the Summer. The educational impulse may be compared to the solar action ; and the way in which nature regulates the one of these which is wholly under the dominion of nature, is a good, and perhaps the best guide in the regulation of that which depends upon man. Nature's plan in the season of animal revival and production, is, as we have said and as any one may see, slow at the beginning, then quickening at a rate increasing with greater rapidity, till these aptitudes upon which it has to act, are brought up to a certain degree of self-action, and then gradually slackening, and leaving the completion of the work to them.

If it were not for what is called the *vis inertia*, or power of resisting action, which is possessed by all material nature, and which is just as necessary to the producing of action in that matter as the other force which it resists, the real seasons in nature, as we observe them in all parts of nature which are seasonally affected, would keep time exactly with the astronomical ones ; and the moment after the winter solstice would be the first moment of spring, the moment after the vernal equinox the first moment of Summer, and the same in the other two quarters. The four seasons would thus, in the absence of this resistance of inertia, correspond in time to the four arcs, into which the annual orbit of the earth is divided by the two solstitial and the two equinoctial points. But even by the calendar we, in our temperate latitudes, are thrown fully the half of each season behind this, and sometimes more, according as the character of the years may vary; and the law of their variations has not yet been discovered to such an extent, as that from the character of any one year we are able to predict, with the probability of being correct, what shall be the character of the next. In this, therefore, as in all other matters which depend wholly upon physical causes, we must content ourselves with taking them as they come, and making observation the foundation of all our judgments. If we wish to understand the seasons in their succession, we must observe the successive appearances which nature puts on during their revolution, just as we must learn the properties of any material object by useful observation of that object, and not by any general theory or analogy.

In training our minds—the only portions of us which are trainable for *general* improvement—we are trammelled by none of the resistance of inertia, which is inseparable from matter. The mind, from its very nature as simple and immortal, never is, nor can be fatigued with action. Exhaustion from fatigue is really a stage, though in ordinary cases it is an early stage, in the progress of death; and it has happened in many cases, and might happen in any case, that it has been carried so far as to terminate in absolute death, from which there is no recovery. If, therefore, we admit the possibility of the very smallest degree of mental fatigue or exhaustion, we thereby give up the whole doctrine of the immortality of the mind, and bring the whole man entirely under the laws of material nature as a mere animal.

Every one who believes the truths of revelation, and every one who understands the nature of man properly, whether he believes the truths of revelation or not—if it be possible for any one to understand human nature without thus believing—must at once admit what has been now stated; and so admitting, it follows, as matter of course, that the mind must be always ready for any subject of knowledge that may be brought before it. Whether the senses of the body,—which are the instruments by means of which the mind receives the elements of knowledge from without, whether directly from the subjects of that knowledge, or indirectly, through the medium of spoken or written language, or any thing else that ensures the same purpose as these,—shall also be ready, is another matter, and must depend on the state of these senses themselves, without any reference to mind, further than that, as is very probable, a smaller hint from the sense may suffice in the case of a mind inured to thinking, especially if the subject upon which the sense gives the hint belong to, or is closely related or analogous to, a train of thought with which the mind has been previously familiar.

In our endeavours to train or cultivate the mind, we might therefore, in as far as the mind itself is concerned, begin at any time. But as we must cultivate it for a state of things in which the body has also to observe, we must take the body along with us. Not only this; but in order that new knowledge, whatever it may be, may find its way to the mind as real knowledge, preparatory of the way for more in future, and not merely as sounds to be repeated, we must see that the trains of former thought have been such as at once to take hold of and firmly retain the new one which is to be introduced.

We must be careful to attend to the fitness of both these elements for the turning of that which we observe, or hear, or read, or otherwise bring before the mind, to proper account, otherwise we may go on for the whole duration of the longest life, in fruitless, however laborious attempts to obtain knowledge, and after all sink down to the grave in a state of most deplorable ignorance. This has been the unhappy condition of so very many, that the means of its correction cannot be too fully explained. I have often felt it in my own case, with a bitterness of anguish which no physical privation, and no mere reverse of worldly circumstances, could possibly have occasioned. The materials of what I felt would have been knowledge of the most valuable and delightful kind, lay thick and invitingly before or around me; but I was so listless or so jaded that I could not observe with the requisite vigour, or my mind was so vacant upon kindred subjects, that it had nothing wherewithal to grapple and to keep the results of my observations. No man is so well able to warn others of the mire, as he who has stuck in it himself; and this is my plea of justification *in limine*, for being a little lengthy upon this subject, at a place where some readers may not expect it.

There is, however, another plea which I shall put in, with a little argument, upon which I feel confident that the reflective reader will give his judgment in my favour; and that is, the very intimate, I may say inseparable connexion which there is between this examination of the foundations of profitable observing, and the Summer as the grand season when there is most to observe, and greatest facility and pleasure in the observation of it.

It requires no argument, merely to convince any one that the readiness and acuteness of the senses to observe, and the preparation of the mind for receiving, retaining, and profitably using the results of the observation, are indispensable. The word "observation" may be taken in the most general sense here, and apply to all information which we obtain from without, by what means soever we may come by it. If we read or hear, it is only taking advantage of the eyes or the ears of others, in those cases which our own will not reach; and if the matter is rightly set before us, the difference between this and direct personal observation is not great, if we have been in the habit of turning that observation to the proper mental account. The cases are innumerable in which others have come after, and turned the observations of others to purposes which never even occurred to the original observer. An instance of this may be of use :—

Tycho Brahe, the Norwegian, was one of the most enthusiastic, assiduous, and accurate observers that ever examined the mighty system of the heavens; and he does not appear to have been biassed by any hypothesis, farther than all men who are formally taught in the schools, are apt to give undue weight to the systems which are there maintained. This is probably unavoidable, as the *Magister dixit* is impressed upon all that the teacher delivers to the scholar, without necessary reference to strictness of philosophical truth, and occasionally, at least in *very remote times*, in opposition to it. But accurate and long continued as were the observations of Tycho, they did not lead him to any thing like a rational theory of the celestial motions, or to any of the laws of these motions. He made an alteration on the system of Ptolemy, no doubt; but though different, it was not better. Tycho was an observer, a collector of facts; and as such he was most valuable: but he appears to have had very little capacity for comparing and generalizing these facts, so as to turn them to proper account. They were not lost, however:—

Kepler, who was one of those rare instances of men, in whom the propensity to philosophize takes the lead of observation, began by scrutinizing the existence of the heavens (then almost the only subject of philosophy—as superstition had laid its *taboo* on nearly all upon the earth) in search of harmonic relations. The mental process was right, even in these early years: but Kepler wanted the requisite materials—the trains of analogous thought, to which we have alluded. He had, however, the good fortune to become acquainted with the cautious and judicious Tycho, who recommended him, "first to lay a solid foundation for his views by actual observation, and then, by ascending from these, to strive to reach to the causes of things." Short as it is, this is perhaps at once the most full and the most philosophical advice which man ever gave to man; and it was not lost. When Kepler was persecuted, Tycho befriended, instructed, and patronized him; and the result was those laws of the planetary motions known by the name of "Kepler's laws," which are the finest philosophical inductions that ever were obtained from observation; and had he advanced but one other little step, the honours which Newton afterwards gained would have been his. It is proper to add, as a warning to those who build theories in nature before they have laid the foundation, that Kepler, great as he was, could not get rid of his early harmonics, but continued to dabble in judicial astrology.

We have given this short account of these two very illustrious men chiefly for two reasons. First, because it proves directly that neither observation without generalization, nor generalization without reflection, is sufficient to ensure the possession of useful truths; and secondly, because it clearly points out the period of life at which observation can be made with the maximum of its two essential parts, abundance and profit, which of course involve present pleasure and future advantage as their necessary consequences.

If mere acuteness of observation were the sole object, then early youth, or even infancy, would be the period; because it is then that the objects of the senses draw the attention most readily and keenly. But they make no lasting impression. One novelty makes the child instantly drop the former one; and though all please it in their succession, it does not appear to give such preference to one over another, as to wish to have it back again instead of one which is quite novel. This therefore is too early a period in life for profitable observation. It is somewhat to be regretted, however, that, as in all cultivated fields the weeds spring up before the corn, and frequently get the start so far as completely to choke it, or at all events to render it of comparatively little value; so, in those early stages of life, when the mind is not yet capable of giving impulse to a valuable crop of knowledge, injudicious treatment may cause the rankest and most foul of all moral weeds to spring up, and utterly ruin the character, before it has acquired strength for laying even the first foundation of goodness. This choking pest of the mind—this weed of most easy growth and most ruinous effect, is *selfishness*, the very bane of human nature. The low-minded parent, how rich or respectable soever in the sight of the world, who has sold his very soul to the service of "Mammon," instils mammon into the child almost with its mother's milk. The toy, even the very first one, must be kept as a property, and treasured, not for any pleasure that it thereby affords, but from the mere fact of possession. The natural impulse of the child is to make a practical analysis of the toy; to pull it to pieces, in order "to discover the cause" of the noise that it makes—noise being the earliest recommendation of a toy to an infant. "To discover the cause," is the grand business of life, the disposition which above all others should be cherished; and if this is sacrificed at the very instant of its first appearance, while it is yet more tender than any bud which made its first opening to the Spring, why, what good can in after life be expected from one who has undergone so cruel a mental murder in early infancy? If you cannot afford the half-crown, the halfpenny, or whatever else it may cost, either in fact or in feeling, by all means let the toy remain in the shop, which is perhaps the better plan in all cases; but if you will purchase it, then, as you value the temporal intelligence and worth of your child, and even its eternal welfare—the loss of which will be requited upon yourself if you peril it—leave the child to do with the toy as it lists; for this is "the door" into future life as a rational being, and he that enters by any other way is "a thief and a robber," for which in him you are accountable.

The early period of life to which we have been alluding is obviously much too early for the useful observation of nature, with a view to the understanding of even the very simplest laws of nature's action. But still, as the senses are more keen then than they are ever after, the exercise of them ought not to be checked; and the moment that the child can understand an answer, either in words or in any other signs, its inquiries ought all to be answered, in order to keep alive the ardour of observation, which is common to all in this very early stage of their existence. At a little more advanced age, the schools often do irreparable mischief in this way, and mischief which the few ill-understood technical scraps, in the "craft and mystery" of making a schoolmaster, (for that is really the end, if it were followed out) can but ill compensate. The prevention of this (there is no cure after it is done) lies in the single fact of not causing it to come in contact with them; but rather to let observation, by the exercise of the senses, which is the proper, and we will add the profitable exercise of youth, be confirmed beyond the probability of distraction, before it is exposed to this serious risk.

It is not to be understood that there is in these observations, any intention of censuring the direction of the minds of children, at any age, however young, to the study of any subject for which they may be competent; but the examples of mistaking the appearance for the reality—the parroted words for the understood meaning, are so very numerous, that the subject is one which requires the greatest consideration. There is also one beacon-star of which we ought never to lose sight: and that is, care not to destroy the disposition to the exercise of the senses. This is born with us, or at all events, it is supreme, though perhaps not sole, at the very earliest age at which we can make ourselves understood; and if it is once deadened, there is no means by which it can be revived at any future period. The hardening texture of the body, the increased activity of the mind in reflection, and after a while the cares of the world, all tend to deaden its energy. Yet it is a power which is not useful simply, but absolutely necessary for us, through the whole course of life; and therefore it ought to be preserved. It has often been remarked that men of high and varied intellectual acquirements, are always fonder of the society of children than those of more dull and formal cast; and that they who display this partiality for these young and ardent exercisers of observation by the senses, are invariably the happiest of their years, the most ready to derive pleasure from every scene and every circumstance of nature;—the persons, in short, whose hearts remain young, even in the extreme age and decrepitude of the body. It is also matter of general observation, that they are the ones who hold out the longest, not merely in the animal performance of the functions of life, but in the actually pleasurable enjoyment of it; and that they quit the world with less pain, and far more tranquillity than persons of an opposite temperament.

This youth of the heart, which lasts perennial through life, has in it a medicine for every ail of the body, and a balm for every wound of the spirit which can arise from physical causes, or from the contingencies of our chequered pilgrimage through life. Every one knows that, when all the skill of the physician, and all the stores of the pharmacopœia have been tried, and tried in vain, a visit to a country which is *wholly new* in the character of its weather, its scenery, and its productions, will, in the course of a few weeks, restore the exhausted limb to the firmness of its tone—replace the hectic flush of consumption by the rich brown of high health—make the lungs to work with fulness and vigour—the tide of the vital stream. to set full and tranquil—tune the nerves to the highest pitch—make the muscles and the tendons like strings of steel—cause the eye and the ear, to which, erewhile, even beauty was a grief and music a jarring agony, to return to their full service and enjoyment, and find pleasure in every sight and in every sound; so that he who departed crawling as the worm shall return bounding as the roe.

And what is the prominent character of the lands which effect these wonderful restorations, after all the skill and the art of man have failed? They are regions of perpetual Summer,—the isles of the eastern Atlantic —the Madeiras, the Canaries, the Azores, the Cape

Verdes, but especially the former; and they are selected because they enjoy *better air*,—a more healthful atmospheric fluid. Are they? Then bring the air to the touchstone of chemical analysis. Examine the atmospheric fluid at London, and at Funchal, or any other part of Madeira; and say what difference there may be in its component parts, or in their proportions; and the answer will be, nothing that even the most searching analysis can detect. It is true that there may be minute particles of charcoal, or muriate of ammonia, or of a few other substances, in the lower strata of the London atmosphere; but assuredly the evil is not in them. The charcoal is a powerful antiseptic, and if it had any effect, that effect would certainly be healing rather than hurtful; and as for the others, they are in very small quantity, and act rather as purificators of the atmosphere than as any thing else.

Still there is a healing influence in the voyage to Madeira, and in the residence there, which would be sought for in vain in the British metropolis; and this could easily be brought to the *experimentum crucis.* Take the hectic youth, on whom consumption has set its mark,—it must be before topical destruction of the lungs is confirmed, otherwise Madeira itself will avail nothing,—take the hectic youth, day after day, to all the stores and treasuries in the metropolis; show him all that is curious and costly in them, and tell him that the whole is his own. Carry him to where the children of pomp and fortune flit sparkling from indulgence to indulgence, as if their touch bred in the most rare and costly chalice of earthly gratification, a serpent ready to invade them with mortal venom; and bid him pile all the coronets on his head, hang all the ribbons and stars about him, and literally bury himself in the mountain of diamonds and other costly gems,—and say to him, "All titles, all ornaments, all festivities and display, are from this moment yours." Nay, take him to the abode of royalty—to that presence chamber, the simple passage through which on levee days entitles many a small man to look down—no, up—with contempt upon many a great one;—place him on the throne, set the crown on his brows, and fetch all the rank and beauty, animate and inanimate, of the land to do homage at his footstool, and swear fealty to him, as the true and legitimate sovereign of these realms. Do all these; and, if the contents of the most wealthy, and gay, and favoured city in the world will admit of it, do more. Will any or all of these things stay the course, or take off the grief of the disease? Not a jot. There is no healing power in any thing which man can fashion or possess. The wealth, the pomp, and the royal power will enter into his soul like iron; the anguish of the bodily disease will be deepened by the bitter fear of the brevity of possession; and the progress to the grave will be accelerated. The truth is stronger than as stated by the Roman bard, that Death—

> "Æquo pede pulsat pauperam tabernis,
> Regumque turres;"

For hundreds, aye thousands, are murdered on sick beds, partly by grief at leaving their wealth and honours behind them, and partly by remorse at the way in which these had been obtained and used. The remark which that sturdy though somewhat cynical moralist, Samuel Johnson, is said to have made to David Garrick, upon the latter showing him all the fine and costly things in and about his villa at Hampstead, embodies in a single sentence the voice and power of a folio volume. "Ah, David, these are the things that *make a man's death-bed comfortable!*"

The observation of nature,—when its scenes and its events are surveyed and contemplated as the works and the workings of God, of instruction and use to man while he is here, but to be parted with in the same spirit of calmness as they are met—and when it is quite free from the selfish idea of property and possession, which is very apt to poison every thing into which it enters, if a higher and more powerful guidance than that of mere man does not interfere and prevent,—has none of those death-bed pangs and remorses in its train. On the contrary, as it gladdens the heart, and makes the pillow downy in health, and restores both body and mind from disease, so it smooths the passage to the tomb for the mortal part, and clears away the mists which hang over the entrance of the haven of eternal rest to the immortal; and peace to the expiring body, and hope to the departing spirit, are the treasures which it has in store for the moment of the last pang.

Nor can it be otherwise: for the possession acquired by observation and reflection, without avarice, or any of the many modifications of selfishness, is a mental possession—an inheritance to the immortal spirit; and therefore, though like that spirit itself, it is begun in time, it goes down to eternity, and is the only species of wealth, won in this world, which a man with certainty carries along with him beyond the grave, as a portion of that eternal bliss, the sources and the sense of which we cannot understand, while the free spirit is encumbered by the clay.

There is one proof of this, which is equally striking and instructive. When men, whom Providence has blessed with good constitutions, and the means of taking proper care of them—which means, by the way, are more easily purchased by poverty than by wealth,—when such are worn to the dust, but worn equally in all their bodily frames, by the load of honourable years which sits easy and remorseless, and their thoughts are loosened from the world before they feel one bodily pain,—when these favoured sons of our race, pleased to have survived and yet not loth to go, revert to the deeds of their former years;—which is the period of life whereto they most fondly and frequently turn? Is it the honours which they gained, the struggles which they made, the victories which they won, the applause of friends or of nations, or any one of the excitements of the prime or the maturity of active life, that returns at the close to calm the mind when the organs of sense are weary and exhausted, and the intelligence which they bring from without is reduced to a very small minum, which shall imperceptibly glide into nothing? It is not. The period of life which comes back at the close is the period of youth, when the senses were free and vigorous in their use; and the subjects which it brings along with it are the productions, the causes, and the phenomena of nature. So habitually and so obviously is this the case, that we, in common phrase, call this extreme of old age "a second childhood;" and if there be any thought,—any remembered act of middle life, that comes in at this time, it comes for no good; for it "bites like a serpent, and stings like an adder;"—the barbed weapon and the burning venom of remorse are always with it, on account of something done or something omitted.

Are the occupations of middle life, to which all the comforts of life, and even the means of knowledge, are so much owing, to be neglected and avoided, then?—Certainly not. They are the talents, the use that we have made of which, He, to whom we are in all things accountable, will specially require at our hands. We are bound, therefore, to improve them with all our strength and all our diligence. But still, we must keep them in their proper place; and the train of remark into which we have been led, with a view to enforce the advantages of observation, preparatory to saying something of the grand season of observing, points clearly to where that place is. We have them not at the opening of life; and if it runs its full measure of years, they vanish before its close. We do not, therefore, bring them, or even the capacity for them (for it is an after-teaching by experience), into the world with us; and we do not take them along with us when we depart. Therefore, they are of and for the present world, modified and regulated by the age, the nation, and the society, in which our lot is cast; and varying with our particular pursuits, and successes or reverses, as mere temporary sojourners. They do not belong to us as men in the abstract, but as members of society. They are put on when we enter into society, and taken off when we leave it; they must be adapted to its conditions, and vary with all its fashions, its modes, and its varieties in rank and occupation. They are proper and necessary during the time that they last; and the proper discharge of them—or, as often, success in the discharge of them—is attended with honour. This, however, is a very perishable kind of honour; and the man who enjoys the most of it may be all the while writhing under the torments of inward remorse and a broken spirit. But as, in these matters, success leads to honour without any very keen scrutiny as to the causes and the means; so failure is attended with dishonour, even though the real causes of it are sterling honour and purity of mind, which would not stoop to take an undue advantage, or get possession of the palace by wriggling through the puddle. Now, success is a contingency, not a certainty; and the ineptness of experience to convert it into a certainty, is proved by the frequency of a second failure, on the part of those who have failed before.

It is clear, therefore, that, in order to be secure in worldly happiness in spite of all contingencies, man must have something more than any business or any profession can give him. The consolation of the Christian Religion is a grand and a sure consolation, which no reverse in life and no disease of the body can shake. But it is brightest for the world beyond the grave; and we wish and ought to have a secure enjoyment in the present life also, in which life it is impossible for us to be wholly spiritual.

But we have seen that it is vain to look to the business of life for this security of bodily or temporal enjoyment,—it is more than bodily, for the mind partakes as largely in it at the time, and treasures it up ever after. It is contingent even in the days of full vigour and activity, and it of necessity fades and vanishes as age and decrepitude come on. We are not more secure in the most endearing relations of society than we are in the business of it; for an unseen hand may be severing our fondest ties, in the very moment when we are in the fullest enjoyment of them, and when the hope of their permanence is the strongest. They, like the others, have their value as far as they go, and life would feel blank without them. Still, they are not enough: we want some means of enjoyment in the world, which shall be our *own*, in unalienable possession for life, and of which no reverse and no bereavement shall rob us.

And where shall we find such, which shall occupy both the body and the mind, as long as they are in union, and the body is capable of maintaining its twofold connexion with the external world and the inward thought? There is but one answer:—In nature—in that which is permanent to us during the whole of life, and yet ever varying so as to be ever new. That can never part from us, though we must some day part from it; and, therefore, in it we must seek the permanence of our earthly enjoyment. It has many advantages, beside the grand one of permanence. It moves not one of our bad passions, or even of our painful feelings. There is nothing on the earth, in the waters, or in the sky, that can in any way provoke anger, or jealousy, or envy, or any one of these stirrings of corruption within us, which, if they should not, as they but too frequently do, lead to the actual commission of evil deeds, yet eat into the heart like a canker, and embitter all our enjoyments. Neither is there in all the countless array of nature's millions, and the endless variety of their actions and displays, any thing which can in the least cloud the brow, or bring any species of sorrow upon us even for a moment. Thus, the more closely that we examine it, the more fully must we be convinced that the study of nature is as permanent as our capacity of following it, and that it can lead to no crime and no sorrow; therefore it points itself out as our best, and only sure heritage, as wholly for the present life.

It clearly follows from this, that it ought to form a part of the general education of every human being. In this respect it has as many advantages as it has in any other. It stands in the way of no other branch of education, and of no other pursuit. Youth must have some relaxation from technical study, and there must be some little intervals in the labour of even the most constantly occupied, besides those which are required for restoring the body by sleep, or refreshing it by food. Those portions are often spent in idleness, and much too frequently in dissipation, the effect of which is to weaken the bodily powers, cloud the communication between body and mind, and shorten the duration of life, as well as impair its usefulness and enjoyment while it lasts. If custom would will it so, these could be easily devoted to the observation of nature, to such an extent as to link every human being to the creation around him, by bands of pleasure which could not be broken.

We do not mean that all, or, upon the idea of a branch of general education, that any should become, what are professionally or technically styled *naturalists.* These make a profession or trade of the study of nature, and of course, in so far as they do this, they come into the same class as those who follow other professions or trades. It is not only very possible, too, but in many instances very true, that these professional naturalists have not that love and feeling for nature, or that pleasure in the observation of all its parts, relations, and successions, which we are so anxious to recommend as an important part of every one's general education. They are far more delighted with a new species of animal, or other production, according to the department which they have taken—for no man can be a professional naturalist in all nature, or even in the whole of any one of its kingdoms—than they are with the most beautiful combination, or the most instructive display of action; and many of them, at least, count themselves far richer in possessing the dead body or the empty skin of an animal, than in the knowledge of all its habits and uses in free nature. In this they follow the law of all tradesmen, and thus establish their inclusion in the class. If most, we may say almost any general merchant, were to be catechised on the nature, production, and general history of all the articles in his warehouses, there would be many blanks in his answers. It would be much the same, at least with *some* professionals, and with many trading naturalists, if they were to be questioned in the same manner about the contents of their museums.

It is quite necessary to make this distinction, because there is a disposition on the part of the people generally, to suppose that an observer and admirer of nature is necessarily one who devotes the whole or the greater part of his time to the finding out of the rarer productions of nature, and examining and deciding upon their minute differences. Hence, there is a prejudice raised against the observation of nature, and the pleasure of that observation, as if they were matters which must, of necessity, waste time and interfere with other and more essential pursuits. It is not to nature alone, but to every branch of human knowledge which is old enough to have been known and named, when science was confined to the schools, and the people ignorant, that this prejudice is applied. Mathematicians are not, indeed, now classed with sorcerers,—and if a Pope of the present day were to denounce "*maleficios et mathematicos*," in equally set and severe terms, as was actually the case in times gone by, we are quite sure that the very schoolboys would "take his *bull* by the horns." There are still many, however, who do not "like the looks" of a diagram; and who have a lingering suspicion that he who is fit for the study of mathematics must so confine himself to that study, as to be useless in all ordinary matters.

This is, perhaps, the strongest ground of the prejudice, because it is either more difficult to give a popular form to the mathematical sciences than to any others, or because the attempt has not been so fitly or so frequently made. Even here, however, there are many instances on the record, which prove that this branch of knowledge is just as independent of mere schooling as any other. Stone was no mean mathematician in his day, and the fact of his being so was found out by the Duke of Argyle, when Stone was working as a gardener to that nobleman; and the partiality of the illustrious statesman and soldier for horticulture proves that Stone's mathematics could not have interfered with his trade. One day, the Duke found a copy of Newton's "Principia," of which there was then no English translation, in a bush; and supposed it to have been stolen, till Stone claimed it as his property, and said he had been reading it at his leisure hours. The Duke put some questions, the answers to which satisfied him that Stone was quite competent to master the book. "Who taught you all this?" asked the Duke. "If a man knows the four-and-twenty letters of the alphabet, what needs he more?" replied the gardener.

The conquering of this prejudice (and it is of the nature of many other things which are powerful in the dark—experience is overthrow) is half the battle in the matter of any one single department of knowledge, and the whole battle in the case of that observation of nature, which these remarks are intended to recommend to all, as a source of much and lasting enjoyment, and as a means of making many of the frivolities and vices which fall upon the vacant-minded in the course of their ordinary occupations; and we trust that we have now said enough to convince every candid mind, which has never before been devoted to the subject—those which have been so devoted need no words of ours—that the love, and a little, it hardly matters how little, of this, are very desirable portions of the preparation of every one who wishes to pass through life as a rational and enjoying being.

This being conceded, and we shall hold it as such,—the next question is that of time—the period of life at which this love of nature can be implanted in the mind, or rather allowed to implant itself with the greatest advantages, both as respects itself, and as respects all other matters which it behoves a human being to know and to do, in order to pass through life in that way in which the wise and good would desire that all should pass.

Upon the general principle, it is never either too early or too late for beginning that which is good; but there is a period of life so premature, and when the influence of the mind over the momentary exercise of the senses is so slight, that little good can be done,—and during this period the strength and vigour of the body are, of course, the principal objects of attention. So, also, there is an after-time, earlier or later in life, according to circumstances, at or after which there are but few chances of advantageously beginning any thing new. We do not say that, even at the very latest age at which the body preserves its tone, and the connexion between it and the mind is not weakened, there may not be hope in beginning; but we do mean to say that, after the cares of life are once fully entered into, the hope becomes weak, and the chances of success in any thing which does not immediately bear upon the business of life, are greatly weakened.

There is one period of life during which, if circumstances admit of the directing of a valuable portion of time to the observation of nature (for that is all which is required), it appears to be more likely to produce good results, and is, therefore, more desirable than at any other. The precise year at which this begins or ends varies with the constitution and previous training of the individual, and with various other circumstances, which preclude the possibility of fixing it rigidly to dates, or absolutely to times of life; but, taking the average, in a rude sort of way, we should say a period of ten years, three of which should, perhaps, precede the age of puberty, and the rest come after it. This is a very nice and ticklish period of human life, both as regards the establishment of the constitution, and the fixing of the character. Earlier than this, there may be an apparent quickness, but there is no decided connexion between the use of the senses and thought. No hold is taken of the world, as if the party felt an individual and independent membership; and the whole mind is so plastic, that it may be remodelled every day without much resistance on its part. But about the period to which we have alluded, there is a dawning of that independent thought and judgment, upon which the party is to be sustained for life; and this is a matter of far more importance than the greater exercise of the senses in earlier life,—though that, too, is of importance, as leading to that juvenile experience which is, as one would say, the basis of this independent thinking. This, however, is the time at which the mind acquires its chief tone and bias for life, and according as the general train of thought shall be directed in these ten years, so will it be very apt to run in all the business of future life.

Besides, this is a period at which, if circumstances can at all admit of it, the burden of bodily labour of any kind should be lighter than at any other period. It is usually the time of most rapid growth, and therefore the one of greatest comparative weakness in the whole system. It is the time when the body is most subject to consumption, and to various other diseases, from which, if this time is fairly got over, there is comparatively little to fear in after life; and such being the case, we may very naturally infer that it is the time when the bodily constitution is rather confined in strength, or given over to feebleness. It is also the time at which the deepest impressions are made; because it is then that the keenness of the senses to observe, and the readiness of the mind to receive and retain the result of the observation, are most nearly upon an equality. The time of perfect equality, may be earlier in some cases and later in others; but we believe that we have truth on our side when we say, that at some time within the limits of the ten years to which we have made allusion, the perfect equipoise of the balance between the senses and the mind actually takes place.

Now, according to a very general, nay, an universal law, which observation and experience show to be applicable in all cases where we can understand the application, and which analogy tells us should hold in the cases to which we cannot see it applied,—according to this, the equipoise of the balance, the time or the position when the beam is in perfect equilibrium in its two arms, and the weight upon neither preponderates over that on the other, is the time and the position when it is most easily thrown off its poise. It is actually under no government, and thus it is in the greatest danger of breaking away into erratic courses. But, for this very reason, it is then most easily affected for advantage, as well as for disadvantage.

Applying this to human beings; the ten years to which we have alluded are those during which every kind of education, in which the faculty of thought is to bear a part, can be conducted with the greatest advantage; and as the rapidity of growth, and the danger of fatal disease, are also greatest at this time, it is the time above all others at which to observe and study nature, as a part of the general education, or preparation of the individual for the study and active business of life. The exercise in the open air which the observation of nature requires, is better calculated than any thing else to give tone and firmness to the body; and the pleasurable nature of the study tends, more than any other that can be named, to protect from the vices and follies with which this stage of life is so thickly beset, and into which so many fall from the want of a pursuit suited to their years.

This is, in fact, the Summer of life, to which we have already alluded : and we cannot help admiring the delightfully benevolent design with which this period of life —the grand period of fitness and disposition to observe— and the Summer of the year, the season when, beyond all others, nature is inviting to the observation, and fitted to reward its exercise, are adapted to each other. But though the Summer is, in an especial manner, valuable and inviting at the age we have named as corresponding to it in our life upon earth, yet every human being, from the earliest dawn of observation to its final close, may find much pleasure in the Summer, if they seek it aright.

CHAPTER II.

GENERAL CHARACTER, OR IDEA, AND ECONOMY, OF SUMMER.

Though Summer is unquestionably the most delightful portion of the year—the one which above all others is hailed and enjoyed by every one who has senses to perceive, or a heart to feel and a mind to understand the great goodness of the Creator in placing man in a world of so many and so sweet enjoyments,—yet Summer is not a season of which we can mark the beginning or the end by fixed days in the calendar, or of which we can say that it has definite characters which belong to it only, and to no other time of the year. Even with us, in the comparatively mild latitude of Britain, where none of the seasons run into extremes, we cannot say that Summer is absolutely the warmest time of the year; because we sometimes have a very warm day in the spring, which, probably from its contrast with the general character of that season, we feel fully more than we do many days in the Summer. So also, there are often days in the autumn upon which we feel the heat more oppressive than we do upon Summer days; though this may in part arise from the greater length and comparative coldness of the autumnal nights.

Our autumnal heats are in this, and in some other respects, not a little assimilated to the burning heats of tropical countries after their continuance has, to a great extent, parched up the ground. After our fields are cleared, and the leaves of our trees and shrubs have either fallen off, or ceased to perform any active function, and become sapless, the heat of the sun tells more powerfully on the earth itself; and, during the day, the earth gives out more heat to the atmosphere over it, and to all that lives or otherwise exists in that atmosphere, than it does in the very strength of the Summer. But this rapid heating during the presence of the sun, is accompanied by equally rapid cooling in its absence; and the balmy night is a far more characteristic feature of Summer than the brightness of the day.

It is the same with the season of extreme heat in tropical countries, except in those places where the supply of humidity is so great that no ardour of the sun can exhaust it. Where the supply of moisture is but moderate, and the place near the equator, the violence of the Summer heat turns the latter part of its continuance into the real winter upon the plains, at least in so far as the growth of vegetables and the support of animals are concerned. Most animals become languid under the influence of extreme heat, but there are none of the warm-blooded ones that become dormant under its influence. The languor of the warm-blooded animals under the influence of heat arises, in fact, from excess of stimulus, whereas their winter dormancy is caused by a deficiency of it.

The case is somewhat different with the cold-blooded animals, whether vertebrated or not, which disappear before the extreme ardour of the season. With us, these are few compared to what they are in climates where the grand characters of the extremes of the seasons are drought and humidity; but they belong to the same classes of living beings: they are reptiles, mollusca, annelidæ, polypi, and infusoria,—all of which find a considerable degree of humidity essential to the performance of their functions, and some of them cannot perform these functions at all without water. With us, the frog, the neut, and the toad, among reptiles, vanish as completely from the open places in the drought of Summer, as they do in the cold of winter. The common slug and snail are examples among mollusca; and although the snail has a house over its head in a shell of its own elaboration, and the slug has none, yet the snail is the first to disappear from the drought as well as from the cold. The common earthworm is the most familiar instance among the annelidæ; for, though it appears in the early and late parts of the season of activity, it does not make its appearance in the Summer drought. One species of *Gordius* is still more remarkable, as it never appears till after the midsummer rains, and not even then, unless those rains are more than usually copious. It appears on the ground, or on the leaves of plants and shrubs. It is about the thickness of a horse-hair, of a whitish colour with a brown head, several inches in length, and capable

ble of twisting its slender body into very curious knots. Its productive powers are great, and when it does appear it is often in considerable numbers; but nothing is known of its manners, or its use in the economy of nature. The aquatic one (*Gordius aquaticus*), is much better known, and very common in the small streams of water; but the vulgar opinion that it is produced of the hair of a horse, and ultimately turns into an eel, is of course without any foundation. These have sometimes been classed along with the *Filaria*, or "thread worms," one of which, the Guinea worm, often produces very unpleasant and sometimes dreadful effects, by getting under the skin of human beings, where it often grows to the length of five or six feet; but these are zoophytes, and parasitical upon other animals, whereas the *Gordii* are free animals, and altogether harmless. The fresh-water hydra, which is little else than a small gelatinous tube, about an inch long, with a few thread-like feelers at the one extremity, and which propagates by a sort of buds—and may be propagated by cutting it into pieces, is an example among the polypi. The infusoria, being mostly invisible to the naked eye, are not so open to common observation. They are chiefly to be found in water in which vegetable matter is in a state of decomposition; and we believe that most of them can be revived by the application of water after having been for some time as dry as dust. These creatures must be considered, however, as occupying nearly the extreme verge of animal existence; and it is worthy of remark, that life always becomes the more difficult of destruction the nearer that we approach to that curious and extreme boundary.

But still, extreme or not extreme, and whether the creature be of giant bulk, or so minute as just to be seen and no more, by the help of our most powerful microscopes, the grand law of the Creator, so bountiful to us as beings capable of acquiring knowledge, and deriving pleasure both from the acquisition and the use, is never departed from. There is always a lesson of wisdom for us, if we will but pause and learn it—and here, in the very smallest, both for common observation and for use, the lesson to us is a very important one. It points out clearly that, in proportion as the quantity of matter in a living creature is smaller and the organization more simple, the life itself is really the stronger—the more proof against the violence of the seasons, and mechanical injury. A whale, though it breathes air in the very same way that land animals do, is able to live but a short time out of the water, while those little animals may be so thoroughly dried, that they could be rubbed to powder between the thumb and finger, and yet, if their bodies are not actually destroyed, they will revive, upon the application of humidity, after almost an indefinite length of time. So also the elephant and the lion can be killed by wounds which do not actually divide their bodies; and divide them with what art and skill we may, we never can get a new elephant or lion out of the pieces; but we have only to continue dividing the hydræ, in order to multiply their numbers to any extent we please.

The lesson here is most instructive;—life is neither of quantity of matter, nor of organization,—of the latter, indeed, it cannot be—for we have no organization but what is the production, the effect of life; and it would be a very strange perversion of language and sense, to say nothing about logic, for an effect to be the cause of its own cause; for it would be exactly the same as saying that a man may—nay, that every man must—be his own grandfather. In the production of every animal and every plant, when the individual produced is new, it is the life that is propagated, and not the organization. But if life is not of organization, much less can it be of mere matter; for matter cannot enter into the composition of an organized living being, without being assimilated by special operations performed by that being, and performable by it only as long as it is in life. But if life is neither of matter nor of organization, there is but one other origin that it can have,—it must be of creation—the workmanship of Almighty power. This is a very simple argument; but, on account of its very simplicity, it is one which no sophistry of those ignorant and misguided persons, (misguided only because they are ignorant and will not be instructed,) who abet the foolish doctrine of materialism, can by possibility overturn. We may add, that if those learned and well-meaning persons, who take upon themselves the task of confuting the erroneous and confirming the doubting, upon that which is most improperly called "*Natural* Theology," would confine themselves to those simple elementary points, which every body can understand, they would do far more good than they do by all their displays of anatomical and mechanical learning. These are, of course, addressed to the learned only, and even with them they miss the very point at issue; for when their learned disquisitions and treatises are stripped of the garnish of the schools, and reduced to the plain language of ordinary men, they amount to nothing more than this—that the Almighty is a better mechanic than man is! for they confine themselves to the created matter, and leave the created power or energy, which is that wherein the attributes of Godhead are especially demonstrated, altogether out of view. But to return,—though this can hardly be looked upon as a digression from our main subject.

We have noticed the dormancy of these animals in the height of our Summer, in order to show that it is not the Summer of all nature even with us; and had we taken our illustrations from a climate nearer the equator, they would have been far more numerous and striking. Even as regards our own latitudes, and our own country, we are very far from having exhausted the cases in which Summer has much the same effect as if it were a kind of winter. We could have instanced many other animals, and also added many plants, of which the Summer is either ended or not begun, while that which we properly call Summer lasts. Of the spring-flowering plants, many have wholly died down, and are not to be found; while others which flowered before the leaf, or before its full development, are now vigorously in leaf, and making their annual addition of stem, or branch, or root, as it may be. These follow an order of succession, the very reverse of the proper

Summer-flowerers, which make their growth as individual plants before they put out their flowers, and having perfected the seeds which are the result of the flowering, they die if annuals, and pass gradually into their winter repose, or a state preliminary to it, if perennials. It is the same with many of the birds, both migrant and resident. They pass into comparative silence and seclusion in the very hot weather, and many of them moult or change their plumage; while some regain their activity and song, and rear second broods, after the rains set in, and bring a second plenty after the exhaustion of many of the more tender tribes during the dry heat.

Limited as the island of Britain is to a range of only about six hundred miles on the meridian, which is just about one tenth of the quadrant from the equator to the pole, there are very great differences in the character and economy of the Summer in different parts of it, and these are still further increased by differences of elevation above the level of the sea, and other local causes. In general, the double season of activity, and the pause during the very rigour of the warm and dry season, are much more marked in the southern part of the island; while in the extreme north they may be said to be altogether unknown. In these remote parts there are hardly any spring flowers, and very few autumnal ones. On elevated places, the snow will retreat before nothing short of Summer; and it returns in occasional showers even in June. Then Summer is hardly gone when the snow returns, and maintains its ground till next Summer. When the duration of

Summer is so brief, there can of course be few instances of second flowering or growth in plants, or of second broods in birds. The plants analogous to the early flowerers of the southern parts are not many; and of the Summer birds which make the southern groves and copses so gay with their songs, the far greater part do not reach the extreme north. There is a double reason for this. In the first place, the Summer is too short, and in the second place, there are few or no groves for them to visit; and on some of the lonely moors there, one may wander the livelong Summer's day without hearing any sound of bird, save the hoarse croak of the hooded crow, or the peevish and melancholy "twite" of the mountain-linnet.

Viewing our own country, therefore, limited as it is in range of latitude, we may say that the Summer is cleft in twain on the warm and dry places of the earth; and that the two segments approach each other as we proceed northward, meeting so as to form only one Summer at different distances, according as the surface is higher above the level of the sea.

But, if this be the case with regard to the Summer in our limited island, much more must it be the case when the whole quadrant is taken. At the equator, the two periods of the vigour of Summer action are nearly six months asunder, and they would be so altogether were it not for the disturbing action of hemisphere upon hemisphere, sea upon land, and desert and fertile surface upon each other.

The period of time which thus divides the Summer into two parts, by coming in as burning drought, may, if we are allowed to represent time by space for the sake of illustration, be compared to a sort of wedge, with the broad end at the equator, and the narrow one toward the pole. We must not, however, consider this wedge as being of the same length in every longitude, or as narrowing uniformly. It is modified by many causes, being sometimes narrowed or obliterated in regions far to the south, as in passing the Alps, the Pyrenees, or even the mountains of Atlas, in northern Africa; and expanding again, as on the plains of Germany and Hungary, and even further to the north; so that, though here, as in many other cases, the theory is good to carry along with us as a general principle, we cannot apply it practically to any one particular place, without ascertaining the character of that place by actual observation.

But though this ardour of the Summer drought, which comes in the maximum of that season in the warmer countries, operates as a temporary check to the activity of wild nature there, we must not suppose that it is on this account useless, far less injurious. It is a surplus of heat, as one Summer power, above what there is of moisture, as the other one, to cooperate with it in its working; and if the deficient power could be brought up to equal this surplus one, this part of the Summer, which burns up the dry commons, might be converted into the Summer of a more active and fertile climate than the native vegetation and circumstances of such places can bear.

Now, this is really a surplus power given to man for his especial advantage, as a cultivator of the ground;

and it is given to him in that very part of the cooperation with his labour, in which he himself can do comparatively little in the open fields; and it is thus one of the most striking instances of the Divine bounty, as holding out encouragement to seek knowledge, and be diligent and successful in improvement. Man may improve the soil by skilful working, and the judicious application of manures; and he may increase, or at all events retain the requisite supply of humidity, by the plants with which he covers the soil, and also by collecting and retaining stores of water, at those seasons when a surplus falls in rain above what is wanted at the time, which is the case in all the rainy seasons in such a country as Britain. Upon a small scale, too, and at a very great expense, he can get artificial heat, as is exemplified in hot-houses, tan-pits, and hot-bed frames. These, however, though they enable many beauties and luxuries of the vegetable kingdom to be possessed and enjoyed in perfection, which otherwise could not be seen within the country in the living state, never would repay half the cost, if an attempt were made to apply them to force the growth of common field produce. But the extra heat which parches the dry plains in the Summer is actually a store provided for man, and provided where he cannot find any thing in art to answer the same purpose. Man can neither cart the sun-beams into his fields, nor collect and retain them in reservoirs,—and, therefore, the bounty which gives him this Summer surplus, is a bounty for which he ought, nay, is bound, to show his gratitude by turning it to proper account. Crops of grain, of pulse, and of artificial grasses, especially the leguminous ones—the taller-growing clovers, the lucerns, and the sanfoins, retain the humidity in a wonderful manner; and all the leguminous crop-plants, which completely cover the ground, are understood to give it more by this means, than they take from it by any other; and thus to be ameliorating crops instead of scourging ones; but, in order to do this, they must completely cover the ground, so as to exclude from it all scorching action of the sun. Plantations, copses of trees, hop-gardens, and all other vegetable shadowings which keep the scorching heat of the sun from the ground, in the times of its extreme strength, have similar effects, only differing a little with the nature of the plants, and the varying demands which their roots may have upon the soil, for that ill-explained and understood something which they are generally supposed to derive from it. In bleak situations, a wonderful amelioration is often produced, by plantations of evergreen coniferæ, especially of the common Scotch fir, (*pinus sylvestris,*) which is, at the same time, one of the most valuable as timber; and there have been many instances of a plantation of this kind yielding a good rent during the time that it stood; and then, when it had come to the growth most profitable for cutting down, the butt-ends of the trees for ordinary deal timber, and the top-cuts for pit-props, used in the coaleries, the surface upon which it stood had accumulated so much soil during the time of its standing, that very little expense sufficed for converting it into corn-land, capable of bearing excellent crops.

These are instances in which the vegetables that man has sown or planted, have, of themselves, furnished no small portion of that auxiliary power of the retention of humidity in the fields, which enables the whole of that surplus of Summer heat, above what the natural condition of the place requires, to be converted to useful purposes. There are other results equally striking and profitable as these. In many parts of the uplands which not many years ago were in the naked and unproductive state which is common to such places when they are neglected, the most advantageous results have been obtained from belts and clumps of planting, and the bringing of the surface into culture. While they remained in a state of nature, the Summers were intolerably hot and dry, and the winters were excessively cold, with heavy falls of snow, frequently coming on about the middle of January, and sometimes renewed in March; so that they lay long, and field-labour could not be begun until the season was far advanced. This rendered the grounds immediately adjoining of little value for tillage, and the wastes themselves of as little for pasturage, as the people in the vicinity had no keep for cattle during the long winter, and sheep were altogether out of the question. When a few cattle were kept in such places, they were in a sad condition in the spring, from the scanty supply and bad quality of their winter food, which consisted almost wholly of straw, unripened, black, sodden, and sapless, from the effect of the autumnal rains. In consequence of this, when the cattle were put out to the upland, after the sun had brought up the grass, a man had to be sent along with them, to lift them, in the case of their lying down or falling, as they had not strength to regain their legs by their own exertions. The change of food had also very unwholesome effects upon them, and many used every year to die of murrain, a disease which was understood to be infectious; so that if it once broke out, it was difficult to say to what lengths it might not proceed. The country people went so far as to say that crows and ravens, which are certainly not very delicate birds, were sometimes poisoned by the carrion of cattle that died of this malady; and when they found those dusky-coated prowlers on the moors, hanging about the outskirts of the herd, they always concluded that these birds "smelt death" among the cattle.

What has been hinted at was not the whole of the evil. The short Summer came on so very hot, that the dry pastures were burnt up, the little patches of cultivated ground in the neighbourhood were hardened like bricks, and the crops late sown, from the length of time the snow lay, could not rise with any vigour in the main stem, or at all "tiller at" the roots, so that it never so covered the ground as to shut out the searching influence of the spring. Thus, as the Summer advanced, there was an approximation to the character of the season of burning drought, as it shows itself in the seasonal desolation of tropical plains; and, as there was no power in the average temperature of the year to produce the bulbous and tuberous plants, which so speedily bring beauty upon those plains when the rains do set in, the general character of the whole was sterility.

There are still many examples of this in Siberia, in some parts of European Russia, in the neglected parts of Poland, and in Canada—where the cutting down of the forests has been prosecuted with more zeal than wisdom; and wherever this has become the case, the evil is always found to be one of the most inveterate and incurable,—one, in short, which the skill of man cannot, at any expense, cure, unless he calls in the assistance of hardy and close-growing trees.

As the heat of the Summer, in this state of things, approximated that of the seasons of drought in the tropics, the result to which it led was nearly of the same character. We may have some idea of what may have been the state of things even in our own country, when we know what actually occurs in those parts of Upper Canada which have been subjected to the injudicious treatment already alluded to. Upper Canada is nearly on the same parallel of latitude with the beautiful plains of Andalusia, with Murcia and Valentia, which, in Spain, under proper management, are lands of almost perpetual crop; and with Sicily, which is still exceedingly fertile, and was once the chief granary of the Roman empire. We may add, as confirmatory of how much the best bounty of Heaven may be ruined and lost by neglect on the part of man, that Upper Canada is on the same parallel with Syria, which, both from the scriptural and other records, and from the ruins which now stand mouldering in the dry atmosphere, or are half-buried in the drifting sand, must have at one time supported a very dense population; but which has now, in great part, become a desert, partly through the continued ravages of long-protracted wars, and partly through the negligence of an ignorant and oppressed, and therefore careless people.

But though on the same parallel with those countries which are, or which once were, among the most beautiful and productive on the eastern continent, and also rendered almost insular by the great lakes, Ontario and Erie, on the east and south-east, and Huron on the west and north-west—all of which are of such magnitude as to merit the name of fresh-water seas,—the Summer on the cleared grounds in Upper Canada is hotter than in the West Indies, while the winter-cold is more intense than that of Lapland.

It is not probable that, at any time, the seasons on the most neglected parts of Britain ran into such extremes as this; but still they were very different from what they are now, and had far more pernicious effects in injuring the health of man, and reducing the produce of the fields to a very small fraction of that which, by proper management, they now regularly afford.

The most disastrous effect of the extreme heat of the Summer in these places, at these times, remains yet to be mentioned. The excessive heat and drought, by resisting, and generally preventing, the fall of the mid-summer rains, resisted the descent of humidity much in the same way that the dry monsoon resists, [See SPRING, Chap. IV.]; and so when the heat and drought had, as in the case of the dry monsoon, actually vanquished themselves by the excess of their own intensity, the autumnal rains came on with great violence, in vast quantity, and of long continuance. The hardened surface did not allow the rain to penetrate the ground; and thus, the slopes were washed of the more valuable portion of their soil, the rivers below were flooded, so that they often carried away the crops, and sometimes the cattle and furniture, and even the bodies of the inhabitants,—thus producing havoc and destruction in the only parts which yielded a crop. Then these rains came before the crops of the middle heights were cut down, and these were beaten to the earth, where the straw was sodden, and the grain germinated. On the higher grounds, again, the rains came before the scanty crops had ripened; and as there is no ripening power in a pelting rain or a dripping sky, that process was arrested, and while the rain continued, the corn remained unalterable in its greenness, unless when it was strong enough to be levelled with the surface, there to rot. Such torrents of rain coming upon surfaces so dry and hot, naturally occasioned a vast evaporation, which brought on cold. The water, in the lower part of the atmosphere, hung suspended in heavy and unwholesome fogs, which invariably brought disease upon the people; and when the cold produced by evaporation had so reduced the temperature of the earth and the lower strata of the air, as that the atmosphere was stilled, and the rain ceased to fall,—the frost almost instantly set in, converting the fog into hoar-rime, and blighting the unripened corn to whiteness, often in the course of a single night. Such crops were really not worth the labour of the sickle; but the people had no other, and lean and unwholesome as the empty husks and the sapless straw were, they gathered them in, as affording the only chance that they had of preserving "the bare life" in their cattle during the winter.

This is no overcharged picture; and it is a picture which, within the memory of some—many, we believe —could, unfortunately for the sufferers, be too often seen, and that not more than a dozen miles from the plains on the sea coast; the abundance, and the certainty of that abundance upon which, made them "Eden to a wilderness" compared to those miserable and neglected lands.

This may seem to be treating of the desolation of winter, rather than of the bloom and beauty of the Summer; and it is not a subject of bloom or beauty certainly, but still it is a Summer subject, and one the knowledge of which is far more useful than any descant that could be written on the most lovely feature of the most delightful and propitious season. The real cause was in the improper management of the Summer,—in the suffering of that part of it which God has obviously provided for man, as that element of successful cultivation which he cannot obtain by his own exertions, to run to waste; and thereby allowing that which has evidently been created for being the blessing of art, to become the bane of nature.

This is a very forcible illustration of the parable of "the talents," in so far as mere worldly matters are concerned. The inhabitant of the bleak upland, on whom the grievous part of this disaster fell, had received only "one talent," and that talent he did not improve; therefore it was taken from him, in the way which has been described: and the result is worse than that stated in the parable; for that which is taken from him, is not given to the man who possesses more of the "talents" of nature's capability, in the lower valley, where the soil is more fertile, and the seasons more mild. The flood does no doubt leave upon his meadows a portion of that richer mould, which the violence of the rain washes from the upland surface; but the flood itself is destructive in the swell and turbulence of its waters; and it is as apt to spoil the meadows with stones and gravel, which the violence of the mountain torrents has torn from their beds, as to enrich them by a more gentle and fertilizing deposit.

There is one other consequence of this neglect of the surplus energy of Summer, which we omitted mentioning along with the rest, and which really makes the winter of such places as we have been describing more destructive of vegetation than the winter of polar climates. The contest in autumn, and that rather early in the season, of which the heavy autumnal floods are the result, is a severe one, and by its severity both the opposing powers are so exhausted, that a period of tranquillity takes place. But it is a tranquillity which is most unfavourable for vegetation, as it has the cold of the northern winter, without the protecting snow. The frost, as we have said, sets in immediately after the rains, and it often continues for six weeks or two months, with hoar-frost nights and sun-shine days, which is the most severe alternation for plants, and the exposed parts of their roots, that can well be imagined. This is protracted till the frost has penetrated to a considerable depth, and all the more kindly plants are killed, or very much injured, while the seeds of injurious ones with which the surface of the ground is strewed, sustain little or no injury, and of course remain ready to grow up and choke the better ones, in the Spring. In this way, the sorrels, and also innumerable hosts of the smaller *compositeæ*, overrun the plains, where one would expect to find grassy pastures; and as these plants are hardy, and the seeds of them ripen rather early, and are very numerous, and winged for flight in all directions, the little vegetation that appears is of the very worst kind that can be imagined.

It is thus that, in the wilds of nature, and without any thing on his part which, in the eyes of man, or according to the enactments of human legislation, is wrong, man is spoiled of the comforts which he might enjoy, and often subjected to the very severest privations, "for lack of knowledge" upon one single point connected with the proper economy and use of the disposable power which is given to him in that excess of the ardour of the Summer, above what wild nature requires, or can have. But though, in being thus ignorant, and suffering because he is so, he is without the statute of man, we find, upon looking into the sacred volume, that the commandment of God is binding upon him even here. That which was given to our first parents, upon their creation, immediately after God had blessed them, must be regarded as the special command with regard to this world, and to it only. They had not then disobeyed the law, and therefore there was no necessity for any allusion to the atonement; and the revelations of God are all as perfect as his laws,—never falling short of that which is required, and never exceeding it. Now, the commandment runs, "*replenish* the earth, and *subdue* it;" and, though there are few words in this, they convey a great deal of meaning. The word "replenish" does not allude to the mere multiplication of the numbers of human beings, because if only that is attended to, the limit which it cannot pass, on account of the physical barrier of the want of subsistence, is very soon reached. If we look at the population of those countries which were discovered by European adventurers, while in a state of the lowest ignorance and indolence, we find that they were a mere sprinkling as compared with the breadth of the country, and in no instance appeared to be on the increase. On the other hand, we can at this day find places in which the population has been doubled within twenty, or even ten years, and yet no other place can be perceived to have become in the least depopulated in consequence of this rapid increase. If, therefore, we would obey the commandment, to "replenish" the earth, in the true spirit of that commandment, we must replenish it with food, and with all the necessaries and comforts of human life, as well as with human beings to enjoy them. Indeed, the replenish-ment in the one way, must be accompanied with, or rather preceded by, that in the others; for this very plain reason, that, though there may be maintenance for human beings, without these beings to enjoy it, there can be no human being without the maintenance. And we have an encouragement to the fulfilment of this commandment, so very general in every case where man has not interfered for mischief, that it is impossible for us not to feel that it also must be of God. Wherever the population is the most dense, the whole upon the average fare the best.

The other part of the commandment, "subdue" the earth, involves all the means which human beings can possibly employ to increase the necessaries and the comforts of life,—all that can in any way contribute to making the path through this life pleasant and happy; so that it does not tempt us to make the world and its possessions the gods of our vain adoration, and draw away our attention from the faith, and the hope, of another, a better, and a more enduring state of being. This primary commandment of the Creator, to the common parents of the whole human race, of necessity, and very evidently, embodies an injunction, to acquire all the knowledge that can possibly be acquired respecting every production, and law, and occurrence in nature,—to find out, with the strictest diligence, all the useful purposes to which those can be applied, the best means by which the application can be made, and the readiest, easiest, and the most certain manner in which these means may be applied, so as to secure, as far as human knowledge and care can secure, the good which the subject, whatever it may be, is capable of affording.

This commandment, though relating only to this world, as at first given and in its primary signification, is yet as much a commandment by the Almighty as any other contained in the sacred volume; and when we consider how much ignorance and misery the neglect of it may entail, not upon the offender merely, but upon societies, nations, and ages, it really becomes one of the most momentous in its extent and urgency, and one of the most fearful in the breach. If we take it even in its secondary sense, its bearing upon the influence of the gospel, we find that it is highly important. Ignorance and prejudice are the most stubborn obstacles to the diffusion of Divine truth, as well as of truth of all other kinds, and they belong to, and have their foundations in that world, which, according to the express terms of this commandment, we are to subdue.

It appears, however, that this, the first and most general commandment, without obedience to which not one of the rest can possibly be obeyed in a rational manner, is the one which, above all others, is lightly treated or wholly neglected. We restrain a man by penal laws from hurting his own body, and we bring down the whole weight of punishment upon him if he injures the bodies, and especially the *property*, of others, which "property" appears to be "the apple of the eye" with human legislators. All this is right; for person, property, all things that can be named, ought not to be injured in the least degree. It is all well to attend even to the most minute of such matters, just as under the Jewish ritual it was all well to tithe "anise, mint, and cumin;" but we must not omit the "weightier matters of the law—judgment, mercy, and faith." While we legislate for the body, shall we neglect the mind, and yet be without the reach of the Divine statute? Shall our care after property, which at best is only the possession of the body for a limited time, be any excuse for our neglect of the cultivation and spread of knowledge, which, so to express it, is the eternal food of the mind? It cannot be; and therefore, if we remain in the grossness of ignorance, and that which a little knowledge and a little exertion on our part might cause to be the blessing of thousands, is running to waste, or even converted into an evil, and we sit in listless ignorance the while, will not the Almighty call us to account for these things? If we must give an account of our stewardship in matters affecting our bodies only, which are soon to be laid in the dust, can we suppose that no account will be taken of that most precious gift, a rational and immortal spirit, capable of acquiring knowledge, and of turning that knowledge to account? God created us *as men* for immortality, and gave his own eternal Son to save us when we had, by our disobedience, forfeited our claim to happiness in that immortality; is it then consistent that God should ultimately judge us *as beasts* which utterly perish when the animal life ceases? The very thought seems absurd—outrageous of every principle of common reason: the action must be more so—and yet we persevere in the action through life, without one scruple or movement of apprehension in the most tender conscience. Thus, when we follow out the simple fact of neglecting to turn to proper advantage that surplus-bounty of the Summer heat, which was obviously intended for our benefit, we find that there is a very powerful moral lesson in it; and it is even so with every production and phenomenon of Summer, and of every other season. This is the grand improvement of the knowledge of nature, whether in its co-existences or in its successions. We shall not be able to give another instance of it in this volume; but the reader *can* always find it for himself,—and *should.*

It is pleasant to view the contrast which is produced, when this surplus of Summer energy is seen and appreciated, and so made to perform useful work in its own season; and though, at that season, the effect is delightful, and greatly heightens the charm of the Summer, it is not confined to that season, but extends to the whole year, rendering every season more healthy and productive, and greatly adding to the enjoyment of life.

When the excessive ardour of the Summer is thus turned to good account, in the promoting of growth, and cooled by evaporation constantly going on from fields of corn coming into bloom; when the bean and the red clover give the full volume of their combined perfumes to the lightest zephyr that flits from field to footpath; and when the fields are cultivated up to the power of the season, the little zephyrs do sport at these short journeys, as if they were specially commissioned to sweeten your path as you walk along; when the hay-field, ready for the scythe, plays in gentle undulations, as if it were a sea of beryl; when the rich pastures, starred over with the sweet though lowly blossoms of the white clover, breathe balm and honey combined, and the industrious bees are flitting from flower to flower, softening the air with their mingled hum of delight; when the fresh breeze from the copse fans you as you pass, and the trembling poplar by the brook salutes you with all its leaves; when the birds, many of them from transequatorial climates, are enjoying their meridian siesta, in order that they may pour forth their gratitude in vesper or in matin song; and when man, and all that belongs to man, living or dead, speaks of plenty, and comfort, and high health, and full and grateful enjoyment:—then, then it *is* Summer, such as becomes rational man in a land highly privileged by a bountiful God: and you require no verbal definition.

This is the triumph of skill and industry, the most noble and the most valuable of all earthly triumphs that can be won by the human race. You know that nature and art have shaken hands as brothers; and though art is of course by much the younger born, you can see that they are twins in manhood—brothers of equal health and strength. You can tell it by these little voices, which, though it is drawing toward the equinox, and there is not one cloud in the noon-day sky, call and answer from field to field, and from each of every two varied surfaces to the other, so softly and gently, that they can be under the control of no master but one. The slight moving of the hay, and the short twitter of the poplar leaf, tell you more truly and forcibly than any words can do, how perfectly matters are on the balance here; and as they play, now this way now that, they show you that the poise is so delicate, as that a little fraction of a grain could turn it either way.

If humidity had had the preponderance, there would have been a dull gummy appearance in the sky. If there had not absolutely been clouds hanging low in the air, and boding showers, to continue the green growth where it was not wanted, and rob the ear for the sake of the straw, then there would have been a rank odour from the copse, to intimate that the fungi were on their way, and that some of their light troops were even now invading the imperfect grains of the corn.

If, on the other hand, drought had had the dominion, not a zephyr would have stirred, not one field would have had communication with another. In that case, the air over these fields would have resembled that in the chimney of a furnace, the action of the sun on the earth and the lower strata of the atmosphere answering to the fire. The air would thus have been in constant ascent, to a greater or less height above the surface, in proportion to the extent of that surface and the degree of heat. To supply this, it would have drained all the less parched places around it, and so crept onwards, invading them with its own character; and according to its intensity, withering the leaves and drinking up the ponds and little streams of water. Under such a state of things, there could have been little or no action between the parts of the surface; and from the upward motion of the air when clear, a dead sultry calm would have been felt at noon-day. But the stirring of the light winds over short distances shows you that such is not the case,—for all is working, and working for the best.

But the advantage of cultivating up to the full power of the Summer heat, does not stop here. The perfect balance, which allows the zephyrs to play from field to field, will of course be equally ready to obey any seasonal change. Accordingly, the midsummer rains get down without resistance; and thus they occur early in the season, just, we shall suppose, when the blooming of the wheat is so far over as that they can do no harm, and while yet the ear is too light for bending the stem, and causing the crop to lodge. The hay is also in general made, and safe in the rick; and the rain comes at the very time when the refreshing which it gives to the aftermathe is the most beneficial. There is, in fact, hardly any thing about the broad culture of the fields to which this midsummer rain is not beneficial. It revives the corn for the swelling and ripening of the grain after the exhaustion of flowering; it revives the pastures; it washes the remaining insects from the trees; and bathes and waters the whole of the surfaces, bark, leaves, and fruit, and gives vigour to the second shoots of the year, in such plants as have the habit of producing them. The turnip, the potato, and all the roots for winter use, also feel its advantages;—it is, in short, a blessing, and a great blessing, to all the cultivated produce of the country. Its effects on the wild vegetation are not so well known; as they who are habitually in the country, and have the best means of observing, are not so deeply interested in these.

Coming easily, it comes with comparatively little atmospheric disturbance; and in moderate climates, where the cultivation is general and well conducted, there is not much lightning and thunder, and the lightning is seldom dangerous. In this respect, there is of course a very considerable difference in different seasons. A very dry season will, of course, have much of the effect of a more arid surface, in protracting the time of the rain, and increasing both the violence of its coming and the quantity when it does come. In such a season, the chance of lightning and thunder is greater; but when the resistance of the warm earth exceeds a certain degree, it is doubtful whether the surface damage from lightning is so great. In that case, as in the regions near the equator, great part of the battle is fought in the sky; and though the lightning is splendid and even terrific during the night, it belongs more to the class of broad or sheet-lightning, between cloud and cloud, than to that of narrow or forky lightning between a cloud and the earth, which last is the only form of lightning that can possibly do harm on the surface. These protracted midsummer rains are very apt to be thrown back into the harvest season; and accordingly a severe and long-protracted drought in the Summer, is not a presage of a good harvest, or an agreeable fall of the year.

The old story about St. Swithin's day, although much exaggerated in the common notion of it, as all such stories generally are, has yet some little connexion with the general characters of different seasons. It must be considered, that the change of the style has thrown this imaginary saint a good deal out of his reckoning, or rather it has thrown those who notice this day a good deal out of theirs. With the day allowed in the closing year of the last century, St. Swithin's day is now thirteen days earlier in the calendar than it would have been by the old style. It is true that the calendar had departed from the seasons, and not the seasons from the calendar, but the departure was slow, and the adjustment at once. Thus the true St. Swithin's day, according to the story, is about the twenty-eighth day of July, and not the fifteenth, as set forth in our present calendar. There must, therefore, be a considerable difference as to the rains and this day. How it may stand with the saint, is a matter not worth inquiring into, only we may hint that the alteration of the style appears to have put most of these anniversaries wrong; and the farther wrong the more modern that they are.

When a moderate Summer brings these rains early, mildly, and in moderate quantity, they operate in some sort as a second spring; and many of the birds come into song and have second broods; and it is probable that there is a fresh production of caterpillars for their food, or at all events, a larger production of the late ones than when the rains are more violent and protracted. Many of the herbaceous plants also bloom anew, and the autumn is long and pleasant, and has very many of the charms of a Summer, though without any very powerful operation on the productions of nature, farther than a very excellent preparation for the coming year, whether in buds, in roots, or in the labours of man. Such a season is also one of plenty, or at all events of excellent quality in all the productions of the soil. The wild animals partake in the general abundance, as that food which is left for them in the fields, after man has gathered in his share, is both more abundant and more nourishing. When there is much moisture from the protracted time and great quantity of the rains, many of those seeds germinate, while in mild seasons they are left as food for the wild animals, chiefly the field-mice and the birds, which again form part of the food of the predatory ones.

In strict chronological distribution, these remarks apply to the autumn, rather than to the Summer; but they are effects of Summer causes, and can be best explained along with the notices of them. If, indeed, we wish rightly to understand the seasons, we can never accomplish our purpose by marking off each season according to the calendar, saying what is to be said within these calendrial limits, and saying no more. This would be taking the mere bones of the year, or rather the bones which men have given it, and which are quite disjointed and—very dry. Every season takes part of its character from those which precedes it, and stamps some part of the character of those which come after, so that the influence of the peculiar character of each Summer lasts till the following Summer; and it may be said to be the same with all the other seasons.

But this succession does not stop with one single revolution of the year. It goes on year after year; and we may say that it goes on in continually increasing deterioration or improvement, according as circumstances, natural or artificial, give a decided impulse to the one or the other. This holds good both in wild nature and where man interferes for the purpose of cultivating, though it is under the latter state that we are most interested in it,—as it is then, in part at least, in our hands, and we are sufferers by the deterioration, and gainers by the improvement.

In wild nature, and without reference to the labour or the art of man, we feel disposed, from the most careful survey that we can take, to say that the natural progress is toward deterioration. It may be temporary in one place and constant in others, but really the impress of that wearing away towards decay, which is conspicuous upon every production of every land, is also to be traced, though not so conspicuously, upon all the lands which produce them. In some places it is far advanced, and in others it is a little way, or it may be barely perceptible; and in some it is rapid, while in others it is slow; but really it is every where. And, although we cannot bring so vast and shadowy a subject within the limits of our narrow science, so as to make it matter of calculation; yet, as an animal produces only a limited number of broods and dies, a tree a limited number of crops of fruit, and withers, dries, and falls to the ground; so, after a certain succession of changes, the number of which we cannot know, a continent may, probably must, be gathered to its last home in the deep. So, after the production and the ruin of a certain number of continents, a planet may be no longer fit for the office for which it was prepared; and in the same way, in God's good time, (for we cannot in knowledge make it ours,) the days of suns and systems, and the whole material universe, may be numbered; but there is One who will remain unchanged, and the spirits which he has made are safe in his keeping amid the final ruin of material nature. That such should be the case is in strict accordance with all that we can observe of material nature; and the analogy would lead us to conclude, that as the Lawgiver is one, the law also must be one; but the disparity of the subjects is too vast for the establishment of any thing like a rational analogy.

There is one thing, however, which no one who looks at the subject, even with the most cursory glance of the eye of knowledge, can fail to see and appreciate; and that is, that the grand cause of the deterioration of lands, is that surplus action of the sun, which, as we have mentioned, is, according to the observed results, greatest at the equator, and becomes a minimum, or nearly or altogether vanishes as we approach the pole,—we say the "pole," not the "poles," because our information does not extend to the south one. In the polar climates we have a sterility arising from cold; but it is a heaping-up, not a destruction; and the result of it is those peat bogs, which sometimes form on the summit levels, and rise high above them; but these appear, in the end, to have a tendency, at least, to work their own cure; for when they rise so high as to become dry, they return to the dominion of the sun, and become clothed with a new vegetation.

But for destructions by solar action the earth does not appear to have any cure. Southern Africa, worn as it is, to the bones by the deep courses of the rivers, which have, in many places, let out the water of every pool, and cut off the sources of every spring; many parts of Mexico, and great part of the central latitudes of South America, to the westward of the Andes, and various other portions of the tropical world, together with most of Northern Africa, Egypt, and Syria, with the plains where the Assyrian and Babylonian empires once displayed their splendour and their strength, might be cited as instances of this. We may also add, that there is no portion of any country, in a latitude of moderate warmth, and which has been left in a state of nature, which does not bear evident marks of this deterioration from the action of heat,—that action which is positively characteristic of the Summer, and of which there is a disposable surplus at that season, and at no other.

In this, the lesson of practical wisdom to us is so plain and palpable, that no man who thinks can either fail to recognise it, or mistake it. A power is given, by the special bounty of Heaven, in the surplus of Summer heat. It is different in different latitudes and situations; but it is not wholly wanting at any place, which man can inhabit and depend upon the land for the whole or the greater part of his subsistence. At no other season is there any such power; and, indeed, except this one, there is not any other physical power with which we can work in any way, except such as is found in or on the earth, or of the atmosphere.

But the amelioration of the soil and the seasons, so that the earth may yield a more abundant, better, and more certain supply, is the first and most valuable of all the labours of man, and of all the applications of his science. To accomplish this, he must work to the Summer. By no treatment of the land, in its breadth, during the winter, can he alter the character of that season a single jot; and the same may be said of the spring and the autumn. We have shown that the autumn is greatly and immediately dependent on the Summer; and the spring must be what the autumn proposes, and the winter suffers to be put forth. The reason is that there is not in any of these seasons a surplus power, of which man can take hold, and work another power up to it by artificial means; for at those seasons the powers are nearly balanced, and thus they neutralise each other.

Thus, when we come to examine the Summer, in its relations to the other seasons, and to man and his labours, we find that there is an importance in it which far overtops even all those beauties of it that have such charms for the whole human race, old and young, learned and ignorant.

And let us ask ourselves, Can it be that this is not specially ordained for our instruction and benefit, by One, who is not only wonderful in counsel and excellent in working, but whose special bounty flows, in divine kindness and abundance, to our humble and unworthy race? If He had not sought our happiness, would he, in the formation of a world—a universe so wide, so wondrous, and so varied—have placed the chief attractions to all our senses in and about that season which contains the lesson of our best earthly wisdom, and the instrument of our most powerful, most necessary, and most useful working? It cannot be. Then, how shall we show our gratitude to him; how shall we, even leaving the gift of eternal life out of the question, come before him with becoming reverence for his greatness, and fitting gratitude for his goodness? "Wherewithal shall we come before the LORD, and bow ourselves before the Most High God?" "HE hath shewed thee, O man, what is good; and what doth the LORD require of thee, but *to do justly, to love mercy*, and *to walk humbly with thy God?*" Such is the instruction which he gives us in his own word. "Truly his yoke is easy, and his burden is light;" and who can feel the depth of sinning involved in even the slightest departure from the law, or the slightest neglect of any one part of the bountiful mercy of One, who is so holy, so wise, so great, and so good? If we depart from him and his law, we need no other punishment, for this is to go into utter darkness, and eternal anguish, remorse, and wo.

CHAPTER III.

LEADING FUNCTION OR OPERATION OF SUMMER.

In the preceding chapter we have endeavoured to show,—or rather to illustrate, for no one who has thought ever so slightly upon the subject can need any original showing,—that there is in the Summer a surplus, or disposable power, not of the earth, but exerted on the earth, which necessarily influences all the other seasons, and which is specially adapted to the use and service of man, and highly profitable to him, if he uses it aright; and it follows, by necessary consequence, that man is culpable, in a very serious degree, if he neglects, or misapplies this power.

When the nature of this power is once rightly understood, and duly appreciated, it leads us to a very clear and satisfactory definition of that which we may, under all the varying circumstances of latitude and locality, properly call Summer; and this, again, leads us to the principal function or operation of Summer, in the economy of nature upon our planet. But when we thus speak of Summer, as admitting of definition, and as performing a function, we must be careful lest this sort of semi-personification should betray us into a mistake. Summer is not, in any sense of the word, a being or substance, neither is it what can be called a cause: it is merely the name of a certain adaptation of the earth to the solar action, by means of which the greatest intensity of that action is brought about; and this explanation, a little shortened, is the definition. Summer is that state of things in which the stimulus of heat, as immediately produced by or resulting from the sun, has the greatest possible effect upon the growing and living productions of the earth.

According to this definition of it, which is the only one which will include all that properly belongs to Summer, and exclude all that does not belong to it, Summer is not restricted to time, to place, or to the particular intensity of action, which may vary with the time, with the place, with both, or by a more powerful terrestrial cause overcoming another which is less powerful.

We must also be careful not to confound the proper power, or action (for the action is all the guide that we have to the power,) of Summer, with the other actions of the year. Of these there are two distinct, and we may say opposite ones, both of which admit of variations,—the action of growth, and the action of decay; considering both as they form part of the varied action of the year.

The action of growth, as being an annual action, and tending only to the increase of the individual in which the effects of it appear, is really a *spring* action, at whatever time it may take place, and not an action of the season whose name is given to that portion of the year in which it is displayed. Thus, if a seed germinates, a new shoot is put out, or any other increase is made to a plant, which has no office, or reference, beyond the increase of bulk in that particular individual, it is equally a process of spring, whether it happens in the season which we call spring, or in any of the other three.

In like manner, the action of decay, or rather of the suspension of growth, *when not subservient to any other action*, is always an *autumnal* action, at what time soever of the year it may take place, and although it should be a solitary action, amid all else acting in another way. In the matter of this autumnal action, we must be careful not to be betrayed into error by the looseness of common language. There are many productions of the year which fall, or decay; and thus we are, perhaps, not very far wrong, when we say, "the fall of the year," or, "the decline of the year." We must not, however, generalize this one step further, or transfer it from the year to nature generally; for, as respects nature, the action of the autumn, or the gradual abatement during autumn, if you will, of the action of the preceding part of the year, is really a conservation, in so far as nature, in its general succession from one year to another, is concerned. In this way autumn may be said, in many instances, to perfect the actions both of spring and of Summer; and in all cases where the general law of nature requires their preservation, it tends to preserve the results of the action of both of these. The autumnal action, in short, prepares nature for a repose in the winter, from which it may be awakened, with certainty and with safety, to the action of the spring; and in so far as the vegetable tribes are concerned, and they are the most seasonal portion of nature, the preparation by autumn is the same in effect, whether a previously existing plant is protected in its substance, or a future plant is treasured up in a seed, a tuber, or whatever else may be the form of its rudimental existence.

In this, however, as indeed in every department of nature, when we view it so extensively as to endeavour to make it a matter of general knowledge—to frame our definitions and descriptions so fully and so freely, as to include every case—we find ourselves beset with many difficulties, and difficulties which we have no means of overcoming; and thus, in whatever terms we may try to define or describe the action of Summer, or indeed any other general action in nature, with the intention of bringing the rationale of that action within the scope of such readers as are but little conversant with general principles, we ought always to accompany our statement of the doctrine with a caution not to carry that doctrine too far, or take any one of the modes in which the result of the action displays itself, as including, or typical of, all other modes, or any other mode. The purpose, in nature, for the accomplishment of which the action is created or ordained, may be one; but the moment that we come to consider the accomplishment of that purpose, we must look at the instruments, or means, by which the principle works,—and these are varied, almost without end. Hence, what we state can never be understood as actually going further than it is borne out by carefully made, and well-proved and firmly established observations. This is the caution which we must carefully take along with us; and, although it seems of so obvious a nature as not to require to be stated, want of attention to it is the grand cause of all our errors in reasoning, in belief, and in action, be the subjects what they may.

Having stated this, we shall proceed to give such an exposition of the action of Summer, which belongs to, and characterises it, as distinct from the actions of the other seasons, as we may be capable of giving of a subject which is so very difficult, and of which the importance is so great, that it makes the very approaching of it a difficulty. In order to simplify the view which we give of this matter, as much as it can be simplified, we shall first consider the general principle, or purpose, to be accomplished; and then we shall mention a very few of such of the practical results, modified by organization, as may seem best fitted for popular illustration.

The purpose in nature, then, which is accomplished by what we may properly call Summer action, and which, therefore, we may, according to our common mode of expression, say that action is designed, or ordained to accomplish, is the continuation of all the races of organized beings, vegetable and animal, by races, or generations, that succeed each other in the occupation of the earth or the waters, and in bearing their part in the general economy of these.

This is the most important page in the whole book of material nature; but it is at the same time the most difficult, and one which involves much mystery, into which our keenest mental perception is unable to look. It is the most important, because it is that which binds the past, the present, and the future, farther than we can look, or even fancy, backwards and forwards, into one connected and continuous chain, in which race follows race, just as effect follows cause. It is the antagonist power to dissolution. Not that it directly resists that, for the exertion of it may always be considered as a step toward dissolution, in the party or individual exerting it; but it secures the race, at the same time that it allows dissolution to cut down the individuals when they begin to "cumber the ground;" and thus, between the two, the system never waxes old, and the species never perishes, except by some of those more slow and mighty revolutions of nature, the productions of which are now, and may to the end of time, remain unknown to human philosophy.

The revealment,—we use the word "revealment," as applicable to the demonstration of Divine power and goodness in material things, in contradistinction to "revelation," as applicable to the same demonstration in spiritual things,—the revealment which the general principle of this Summer action of nature opens up to the reflective mind, is truly wonderful, and, pursued to the full extent, it seems more than the limited faculties of man can bear. The coexistent things which creation displays to our senses, in all those varied appearances, adaptations, and uses, to each other in nature, and to man in art, are both wonderful and delightful. We find in the store, every thing that we can by possibility desire for our necessity, or our enjoyment in this world; and as a material for our art—an exercise for our skill and our industry—for the exerting of thought, and the instruction of the hand in working, we find it as a material, ready prepared—made without hands, and yet fitted for its purpose with the utmost perfection. We find this, whether we seek it in dead matter, in living matter, or in the powers, properties, and energies, which are treasured up in either. We find this at all times and in all places; and let us think and labour as we may, nature is never behind, and we never fail from any want or backwardness there. If we can produce the artist, no matter how nice or delicate his art, nature has all the materials quite ready for him. If we can produce the engineer, who has the requisite skill for applying any power to any purpose, nature is always ready with the power. When the mariner set about finding how he should, on the trackless deep, and under a night-sky obscured with clouds and darkness, steer his bark in a known direction, nature was ready with the curious power of the magnet, and with the steel of which to make the needle, which should be armed with, and should preserve that power. In like manner, when a general power, capable of producing mechanical action, more vigorous, more constant in its use, and yet more varied in its application, than that of animals, of driving winds, or of falling waters, man had nothing more to do than contrive the engine, and nature was ready with the water, and the fuel for converting that water into steam—thereby giving it a force or power of elasticity, which, if the fire is urged to the requisite intensity, and the resisting strength of the apparatus is sufficient, can be raised beyond any limit that we can name. It is true, that for one human being that succeeds in these more splendid appeals to nature, there are many who fail; but the cause of the failure is never in nature, it is always in themselves. They do not understand nature, neither do they understand what they ask of it. Their attempt, expressed in words, is simply this,—"I want something of you, but I do not know whether you can or cannot give it, and I myself do not know what it is." The misguided bungler, who is always "inventing," yet never "invents," must not take offence at this true statement of his case; for, though he may be able to describe the beginning and the end of his proposed invention, the want (and a man always wants what he does not know,) of the very smallest portion of the middle, reduces the whole to nothing. They who are thus deficient must fail, as matter of course; but no man ever went to nature with a proper knowledge of nature, and of his purpose, and a right understanding that he was in the proper way to obtain what he wanted, without obtaining it,—and generally more, in supplement, to exercise and reward his future skill and industry. Thus, the beauty of the whole matter is, that invention, or, more strictly speaking, discovery,—though both words mean "finding out," not "originating," (which is not work for a finite being,)—resemble thought in this, that the more is gained, there appears the more to be gained, and the greater facility in the gaining of it.

The succession of nature in the progress of the individual is still more wonderful than this; and in it we are enabled to draw the distinction between the organic and the inorganic, or, as we may and do call them, the living and the dead. Growth is the most striking phenomenon in this part of the economy of nature; and therefore it is the best general illustration. We know of no such operation as growth, properly so called, in matter which is not organized, and possessed of the power of organization in a state of activity. It is true that diamonds appear to be formed, in not a very great number of years, in some soils, and it is also probable that rock crystals form in some of our own mountains, though the latter case is not so easily established as the former. Neither of these is growth, however, any more than the formation of crystals of common salt, when the water that held them in solution is evaporated, till what remains is no longer able for the task; and thus the tendency in the salt to crystallize, which was overcome by the larger quantity of water, in its turn overcomes the smaller, upon a principle as simple and as general as that the arm of an equipoised balance rises up when the weights are taken out of the scale attached to it. In these, as in many other cases in matter not organized, there are apparent growths, but they are all mere aggregations—gatherings of matter together without any change of its nature. Different substances may indeed be compounded together, and many properties may be possessed by the compound which are unknown in the component parts when separate; but there is not, in all the wonders of chemistry, a single instance of assimilation, or the transmutation of one substance into another, as we find in the organic world. Grass is changed into the flesh of bullocks, and bread into the flesh of men, without any effort or even knowledge of human science as to the nature of the process. But all the labours of the alchymists could not change a single metal into another, how nearly soever they resembled each other in their external appearance; for though tin and lead are not very unlike each other in appearance, it would be just as hopeless to attempt changing the one to the other, as it would be to attempt turning brickbats to ingots of gold, or hailstones to diamonds. There is this further distinction between the inorganic being, and the being possessed of the organizing function: change the inorganic substance as you will, by mechanical or by chemical means; note well all that you have done, and undo the whole of it in a regular reversed order; and you will obtain, not merely a substance similar to that with which you set out, but that very identical substance itself, without the change of a single quality, or the loss of a single particle. It follows clearly from this, that the inorganic substance has no properties but those of mere matter; and that it cannot of itself, or by any other finite means, lose one of these properties, any more than it can be put out of existence by any power, even that by which it was created.

The organic being, on the other hand, never returns, if the function of organization in it is once fairly at an end. This function is connected with, or rather displays itself, in the substance of the being; but so far from being inseparable from that substance, and a primary quality of it, it is in many instances easily separated, and once separated it never in any case returns to the same union. All our chemistry, all our science, by what name soever we may be pleased to call it, fails us here. Let us analyse and decompose as we may, we obtain no knowledge; and the combined skill of all the chemists in the world cannot so distil their bodies as to fetch us in a phial, or other receptacle, the component ingredient that makes a lion eat sheep, and a sheep eat turnips. These remarks may seem irrelevant to our main subject; but that subject is one of the greatest difficulty, and therefore we must endeavour to clear the way to it, even though those who do not understand the subject may think us tedious, and those who do may be certain of it. This will in nowise deter us from our purpose; for though "road-making" is a pioneering work, worthy of only the humblest class of labourers, yet in war, in civilization, and in gaining knowledge, making roads is gaining half the battle—and more.

The progress of the organized individual, as distinguished from the dull quiescence of that which is not organized, is a curious and an interesting study; and if we were not so familiar with it from the very dawn of our existence, we would look upon the very simplest instance of it as an especial wonder. For instance, who that had not seen the fact, would, upon being shown four little grains, not differing much in appearance from those of gunpowder, believe that by simply placing them a little under the earth, and then leaving them, one would become a cabbage, another an onion, a third a turnip, and a fourth a mustard-plant? Yet this is the case, year after year, without the least deviation from the uniformity of the law, unless such, on observation, as we can explain upon principles quite satisfactory. Again, who that upon turning up the mould by the bottom of the wall near the peach-tree, and finding there a few little grains not very dissimilar in size and shape from the others, would believe that before the season should be over, these little grains would become garden-snails, and without feet (they have only one *foot*, and it is not a walking one,) climb up the tree and eat the peaches, carrying on their backs curious houses, which they had constructed of themselves for themselves, without the slightest intention of so doing? Who that saw for the first time a little infant, "mewling and puking in the nurse's arms," unable to point a foot, move a finger, or almost open an eye, and which, if laid down and left to itself, would inevitably perish in its helplessness,—who that saw this would suppose that, after a few brief years should have passed away, this same infant would become the bane or the blessing of its race,—that it would live in crime and die in ignominy, that it would live in cruelty, and muttered curses would follow it to the dust; or that it would set wide the gates of knowledge or improvement, give wholesome laws to nations, or declare the will of heaven to man—blessing and blessed while in life, and followed to the final resting-place of all its earthly labours, and honoured by the streaming eyes of a mourning multitude? Yet such has been the dawn of life to the greatest and the meanest men whom the world has ever seen, and such will be the dawn of life in all ages; for though increase of knowledge, civilization, religion, and all other means of enlightenment, change the character of the full-grown man, that of the infant at its birth is the same in all ages and all states of society. When the eternal Son of the God of all nature, and of the spirits of all flesh, took humanity upon him, in order that he might perform the glorious work of human redemption, as Emmanuel—God with us—he was, in the early stage of his incarnation, "wrapped in swaddling clothes, and laid in a manger," as perfectly man, and as perfectly helpless in the beginning of his human career, as the most ordinary individual of the human race. Need we wonder that the immortal spirit in man does not display itself at this early stage of his being, when we find that the Godhead of the Saviour was not made manifest until the human nature had undergone its development in the ordinary course?

Instances might be multiplied without end; and if we, even in thought, divest ourselves of our familiarity with them by constant observation, they all seem equally wonderful, as there is nothing in mere matter that could lead us to predicate germination of the seed, or further development of the plant or animal, how rudimental soever may be the state in which we see it at the time. Take one who knows nothing of the first appearance of the oak, to the place where an acorn has just put out its germen, and the *radicle* has stricken into the ground, and the *plumule*, or future tree, is a knob not one-tenth of the size of a pin's head; and say to him, "Behold the future monarch of the forest, which shall one day overtop all these tall growths which are now spreading their arms and bathing their leaves in the genial air of heaven;" and whatever he may say, he will inwardly question your veracity. In like manner, take him to a bed of seedling pines, in the first stage of their appearance above ground, and bid him take note of the masts of the navies of future times, and you will equally provoke his astonishment, or his scepticism. [I had once a case myself which made a slight approximation to this, and which was both pleasant and curious; pleasant from the aptitude of my inquirer, and curious from the fact of his not having known these matters before. Though my senior I believe, he was a young man from a part of the country where there are no trees, and his time had been wholly devoted to scholastic instruction, first at school, and then at the university, where he had "gone through," as it is called, the course of philosophy, and had A.M. attached to his name. Circumstances, which I need not mention, led us to spend many leisure-hours in walking, in a place where the scenery was striking, and the trees numerous and varied. For a considerable time, if I made any of those idle remarks on the trees which a youth will sometimes make, he took no notice.

At last we came to a very beautifully spreading beech; and as we were issuing from a clump of Scotch firs, the elegant and unexpected stranger caught my eye.—"What a magnificent beech!"—"*Beech?*"—"Yes."—"Where?" *Fagus!* for Virgil makes a beautiful allusion to its shade in his first Eclogue,—

'Tityre tu patulæ recubans sub tegmine *fagi*.'"

"Tush, man," said I, "it is a grave dispute among the learned in these matters, whether the *Fagus* of the ancients was not an oak—*Quercus æsculus*, still found in the warmer parts of Europe, and by many supposed to have yielded bread for men, before they were acquainted with rolls and butter, or potatoes." "But where *is* the beech?" asked he. We walked under its shade, and I told him all that I knew about it—which was not much. He then told me that he did not know one tree from another; that, up to a very recent period, he had supposed that deals, which came to his country from Norway ready prepared, were quarried out of the earth in the same manner as stones. I told him all that I could about the distinction of trees, and also their qualities, and he was so apt and eager, that he very soon equalled or excelled his preceptor; but at that time the subjects of my speculations, such as they were, were very different from the distinctions and the physiology of trees, though the circumstance tended to shake some of my previous notions on the subject of practical and scholastic education.]

But the annual changes, though trifling compared with the others, as to the total development of the organized being, are well worthy of our attention, if it were only in so far as they show us with what beautiful harmony nature works; so that the smaller cause or impulse to action is always obedient to the greater one, and appears to have its own perfection in this very obedience. Examine a leafless tree in the winter, when all its branches and twigs are pencilled out against the sky, to their very minutest ramifications; and who would suppose, that in a few months it would present a green canopy, through which not a beam of the sun, or a drop of rain, can penetrate. Look at a field where there is not one living vegetable to vary the uniform colour of the clods, or where there are only here and there a few points of yellowish green, with a dew-drop sparkling at each. Notice the congregating birds, flitting from field to field or from field to highway, or perched on the thatch of the stacks in the barn-yard, as if they were chiding man for threshing the grain inside for his own use, and offering nothing for them but the ends of the straw. Some of them, however, do a little more than this; for when matters come to extremities, the little things, and some of them very little—the tits, for instance—may be seen drawing straw after straw very cleverly, and feasting upon the grain; and when one succeeds another tries, and the havoc is sometimes much greater than would be suspected from marauders apparently so feeble. Even the house-sparrows, which, during the more genial seasons, vex the air with their incessant chattering, quit the house-tops, and are silent. The only sound that is heard among all those winged creatures is a melancholy chirp, and that only in cases of extremity;

for while they continue to be even moderately fed they are mute. But see them in the opposite time of the year, and they are all activity and voice, and no matter for the kind of the action or the tone of the voice, for there is an expression of equal energy and activity in them all. One is gathering little sticks under the trees, another is picking up dry leaves under the hedge, a third flies off with a straw ten times its own length; and a little lock of wool sticking on the hedge, or a feather twittering before the wind, is a treasure to a fourth. It is often amusing to throw the knot of a straw rope on the walk in the lawn or garden, when the sparrows are in numbers on the house-top. They very speedily discover the prize; and the chattering they set up puts one something in mind of the cry of "A fall!" "a fall!" which the fishers set up when they see a whale. Down they come, and assail the knot of straw, not "tooth and nail" exactly, but bill and claw, with all their might. They tug, and chatter, and pull some this way some that, appearing occasionally to lose their tempers; for they quit the prize, bundling and fluttering in a heap, and generally retreat to some distance for a time; yet whether any "affair of honour" is settled on these occasions, we cannot tell; but they are sparrows, not men, and so there can be no malice in any of their movements.

The displays of this kind cannot, however, be taken in their details, for life's last sand would be run with the youngest of us before we got halfway through the list. Our life is but a passage; and therefore we must confine ourselves to a passing glance; and that accords with our subject, for it, too, is passing.

Tree after tree expands into foliage, and twig after twig sprouts outwards; plant after plant springs up; and the stem lengthens, and the leaf broadens, till the earth is literally mantled up and hidden in the profusion of its own exuberance. There are no more flocks of listless birds, for all the resident ones have dispersed themselves over the breadth of the country, so that every tuft and bush has its bird, and every copse its volume of song, delivered with endless variations of voice, pitch, and cadence. The air is also filled with smaller wings, and although their owners are voiceless, the rapid motion of their organs of flight produces a hum of activity, which from one race or another ceases not day or night. These, of which hardly one is ever to be seen abroad in the winter, come out of all sorts of hiding-places. Many are from the waters, where some had been lodged in the sludge; others had made curious dwellings of little sticks, of vegetables, or small pebbles and shells; while others again, armed with powerful jaws, had been the terror of the rest, under the stilly surface of pond and pool, where common observation could not find them. Other tribes, again, are from under the earth, where some of them have summered and wintered for years without once beholding the light of day, or having any organs for the purpose. There are others, still, which come from under the bark of trees, where they have been first feeding themselves fat, and then reposing for a space, in order that they might appear in full vigour. Every hole and cranny has its quota to send, and not a few have been hung up for all the winter in cases of their own preparation: while myriads come, after a little pause, from their feast in the vegetables—and sometimes in the bodies of the larger animals, which have supported and nourished them from the egg upwards.

Some come from one place, some from another; but no matter, here they are, buzzing and beaming in the sun, or piping and droning in the "dull ear of night,"—which by the way is a misnomer, for night is the very time for ears, which are often deafened by the eyes during the day, as we feel to our cost. Night or day, here they are; and the one which was blind under the earth or in the waters, now owns and exercises some thousands of eyes. Then they have cast off the form of the crawling worm, and the slow and cold reptile with its many feet, and its occasional spinning of threads to prevent itself from falling. They are gay with wings, plumed or unplumed, naked, or covered with horny shields; and the lustre of every metal, the glow of every gem, and every shade of tint in the bow of heaven, is found among them in the highest perfection.

But even the waters, in their own peculiar inhabitants, partake in the general impulse; and the pearl, and silver, and gold, which are on their scales, have double lustre at the time when all the children of nature are concentrating their energies.

And we must look back at our graceful and lively favourites the birds, which leap about in the air, with as much apparent ease as if they were beings of ether, and had no weight of matter to bear up. Stranger after stranger arrives; all that have wintered are in activity. All are in fair and bright attire, and not a few are decked out with ornaments which are unknown to them —that is, unworn by them—at other seasons. Some have mantles, others waving plumes, others again have collars and stars, and various ornaments; while not a few are so decked out that one familiar with them in winter would not recognise them.

All, in short, have on a nuptial attire of some kind or other, and are gayer creatures than they were in the days of their young and rapid growth. Can all this be for the merely selfish purpose of adding to their personal bulk, and size, and enjoyment; or are they to play human nature upon us, and win confidence by the respectability of their outward appearance, and so accumulate wealth? It cannot be; for the day comes to them, and the dinner with it; and their almighty Author finds them in clothing and lodging better adapted to all their necessities, and far better adapted than any that man can procure for himself, by all the abundance of his wealth, and all the ability of his art. "Then why all this abundance, this splendour of preparation, this unprecedented activity, which has called countless thousands of creatures from the cold damp of the waters, and the dark oblivion of the ground, to play and wanton in the beams of the sun, as if they had been made for spending their whole time sporting and pleasuring in the brightness of its radiance, and the highest fervour of its heat?"

Turn round. Here is something that will stay till we question it, which these gay and jovial creatures will not do. But let us "gird up our loins like men;" for, if we are to get wisdom and understanding, we must trench on "the extremest bourne," not of the mere works of material nature, but of the very workings themselves. We cannot, we dare not, lift the vail; but we must come near to the seat of Him who sitteth throned above all heavens of our imagining, as "the Ancient of Days," with "the issues of life" in his hand; and herein there is no created thing between us and our God. It is "holy ground;" and therefore we must tread warily, and seek strength in Him who alone can strengthen us.

Turn round. Do you mark that tree, that shrub, or that other plant, gay with expanded blossoms, displaying in them a delicacy of texture, an elegance of form, a beauty of colour, and a richness of perfume, which are elsewhere unrivalled both in art and in nature? Note the texture of the petals—you have not a name for it in your language, be born in what part of the world you may. Note the exquisite symmetry which sends man to try his skill, mostly in the imitation of a flower, if he would have any ornament of superlative elegance; and yet there are ten thousand of these symmetries about you, and all equally symmetrical. Then, the tints of colour, so rich, so varied, so indescribable; you dash from you the pencil and the palette, and are rapt in speechless admiration. The perfume is the very fulness of delight to your sense of smelling; but you cannot tell in what it consists, or how it is wafted to you, viewless, on "the viewless air."

And has this, or any part of this, been prepared or done, for any thing that can be regarded as selfish on the part of the individual plant, as contributing to the increase of its bulk, or in any way to its renown among the other plants of the field? Not in the least; for, on the part of the plant itself, it appears really to be a sacrifice. Examine every individual portion of it upon which a flower is produced; and you will find that, whatever may be the condition of the rest of it, the growth of the individual has ceased in all the flower-bearing parts, never again to be revived or renewed.

In the details of this, plants vary according to those differences of structure, habits, period of duration, season of greatest action, and all the other distinctions, in consequence of which vegetable nature is so delightfully varied, in different places, at different times, and even in the same place at the same time. If the plant is a simple annual, which springs from the seed of a former year, rears its stem, puts forth its blossom, and ripens its seed, and then perishes; the flower is the last act of its growth or living action as an individual. As the flower begins to expand, the action in the other parts of the plant abates, and there is no addition even of the smallest leaf. When the flower is perfected and the seed fertilized, the maturing of the seed, and the drying up of the plant, go on together, so that, by the time that the seed is ripened and fit for being called out by the action of the proper stimuli, when the course of the seasons brings these round, the old plant is dry and exhausted in stem, root, and leaves; and no power in nature or art of man can call it into living action anew.

There is something worthy of attention in the parting of the old plant and the seed, or rudimental form of the new one; because there is something very analogous to it in the whole of active nature, both vegetable and animal, and also in the shedding of the leaves of *deciduous* plants; indeed it is from this that these plants get their name. Up to the time of the young plant, or young of any kind being perfected, in so far as that upon or by which it is produced is concerned, there is a connexion between them, and the parent supplies the young one with nourishment. This nourishment must not, however, be confounded with the kind of nourishment which the system of the same plant or animal affords to any part or member of its own body. The *embryo*, as we may call it,—that which is to "break out," or "burst forth" into the perfect being of which it is the rudiment,—by means of *its own* capacity of obedience to the proper stimuli, is, from its most rudimental existence, a distinct being; and whatever may be the kind or duration of the connexion between the parent and the offspring, it is a close juxtaposition only, and not an absolute union. There is a very curious partition somewhere in the connexion, though, in the very early stages, it is too fine for being detected by our very nicest observation. This partition is technically called *membrana decidua*, which means the membrane which parts—splits in two, and heals the parts which are separated, or one of them, in the case of a parent whose habit is not to survive the production.

In the mammalia, which bring forth their young alive, this curious partition is more conspicuous than it is in animals which are produced from eggs, or in plants; and it is always the more conspicuous the more matured the young are at the time of their birth. In these we can trace the vessels from the parent animal, branching and lessening as they proceed toward the partition, till they become lost; and no microscope or other means can trace them to their terminations. Just so, on the side of the young, we are unable to find the beginnings of the vessels, though, after a little way, we find them converging into larger vessels, and proceeding to the system of the young. But it is not the same blood which we meet with on the two sides of this membrane. The rate of the pulse is more rapid in the young one, and the globules of the blood are of smaller size. So different are they in this respect, that the blood which circulates in and nourishes either of them would not do for nourishing the other. There is a transfer of nourishment; but upon its passage it undergoes a wonderful change, and the probability is, that it is divided to the ultimate atom in passing the mysterious partition which we have mentioned,—completely decomposed as part of the old animal, and again recomposed as part of the new one.

As the passage from race to race in the living and growing would become more simple, that is, as the young become less intimately connected with the parent in its development, this distinction between them is not so clearly seen. But we have reason to believe that it is perfectly general; and that, even in those plants and animals of simple organization, which produce their young in the form of buds, or *gemmata*, on different parts of their own bodies, there is still a *membrana decidua*, which splits and separates the two whenever the young one is capable of supporting an independent existence.

In regularly flowering plants, which bring their seeds to maturity in a seed-vessel, as, for instance, the bean, the pea, and other legumes, the mark of this healing off can always be distinctly seen in the *hylum*, or eye of the seed, as it is called; and it is within this that the different parts of the seed, the coats, the cotyledon lobes, and the embryo of the future plant, have their common union. In the egg of a bird there is something not very dissimilar to this; for there is a *cicatricula*, where the union of all the parts of the egg takes place; and there the embryo of the young bird is situated, and from thence the vessels begin to be formed in the placental part of the egg. Thus, there are really two generations, or, which is the same in effect, the functions of two generations both in the seed and the egg. There is a maternal part from which the nourishment comes, as long as the plant is nourished by the seed or the bird by the egg; and when this ceases, there is the parting of a *membrana decidua*. It is only in particular cases that this is apparent to our observation; but we have no reason to doubt that the law is, like all the great laws of nature, perfectly general and simple.

In the case of corn, this is so well known, that it is observed, and has a name given to it by the country people, who often observe much and accurately, though their observations are generally lost from not being recorded. There is a short period during which, even in the most favourable state of the weather, the young corn looks pale and sickly, and instead of growing, appears to be receding down into the ground. They are not alarmed at this, as they sometimes have occasion to be afterwards, when the attacks on the roots by underground larvæ occasion a more sickly yellowness; they merely say that the corn is "going off the seed," which, being a natural and necessary part of its progress, produces no alarm. There is, however, a weakness at the time of this transfer from one means of support to another, which does injure the crop, if the season is more than usually backward, or the land in bad condition.

In the case of all continuations of the species by flowering, and probably in all cases of production whatever, this production appears to be the final exertion on the part of the plant; and the process of flowering follows the Summer action—namely, the action of heat and drought. Any one who is in the habit of noticing the wild parts of nature—the heaths, the commons, the banks under the hedges, and all other places where vegetable nature is allowed to have its own way—will not fail to notice that, up to the extreme at which parching and destruction begin, flowers are far more abundant and fragrant in dry seasons, and green growth in those which are humid. It is the same with places differently exposed. Examine any range of hills that extend nearly east and west, and thus have the southern slope alike turned to the sun, and the northern away from it, and you will find there pastures and many wild flowers on the south, and better pastures, with fewer flowers, on the north. The Grampians furnish many instances of this, for the southern slopes are often one carpet of wild flowers in Summer; while the steep slopes to the north are much richer in grass, and show very few flowers. Even the shrubs partake not a little of this character: the richer parts of the southern slopes are often gay with the golden blossoms of broom and furze for many continuous acres, so as to give a brightness of contrast with the wild thyme, and the other more humble plants in the intervals; and fill the air with an odour which, though it has no name among the labelled perfumes, yet raises the spirits in a manner which must be felt in order to be understood. The northern slopes of the same hills are without a single yellow blossom, and the shrubs are for the most part ragged junipers, looking as cold and repulsive as if newly imported from Lapland.

The consequence of this is an excessive production of the seeds of all wild plants upon these sunny slopes, and a choking of the corn by marigolds and other annual weeds with composite flowers, where the soil is thin and the farming slovenly. These places have, in short, a surplus of Summer action; and though, with high culture and skilful treatment, they can be made to yield early crops of the very best quality, yet they require preparation proportionate to the influence of Summer upon them. The opposite slopes are naturally richer soil, and they do not require the same attention; but the crops of them have more tendency to run to straw, yield grain of inferior quality, and are apt to be overtaken by the frosts of autumn.

Though there are many perennial trees and shrubs that can be propagated by cuttings, by grafts, by buds, and by various other modes of converting part of the old plant into a new one, without any operation of flowering and seeding; yet, considered merely as a plant, the one which is obtained in this way is always inferior to that which is raised from the seed. This does not hold in the case of many of the uses for which trees and shrubs are cultivated; for if fruit is the object, there is always a more abundant and superior crop on a grafted tree than on one which is left on its own natural stock; and the artificially treated one also comes sooner into bearing. A rose, too, when worked on a stock of brier, has more abundant and beautiful flowers than when it stands on its own root.

When a plant is in its natural state, and exposed to the mean temperature of its native climate, all the parts of it work in an equal ratio; and the tendency is to make the greatest addition to its own structure, both in the single growth of the year, and in the general size from the growth of successive years. The necessary result of this is vigorous shoots and abundant and ample leaves; and as it acquires what may be called "a momentum of action" in this its individual growth, it can continue the effects of that action longer, and against more powerful causes, than if it had less of this momentum. This acquiring of a momentum runs through the whole of material nature, from the motion of a planet in its orbit, to the growth of the humblest plant; and if we do not estimate it, and allow for it, we are sure to go wrong in our conclusions.

The momentum of self-growth which the vigorous plant thus acquires, resists the action of the Summer carrying the time of flowering further into the season, and often resisting it till the proper season of flowering is over. On the other hand, a feeble self-growth, and a correspondingly small momentum of that growth, are easily overcome; and the flowers are early and abundant, though the plant, as a plant, is sickly, stunted, and short-lived. We have practical evidence of this in many of the common fruit-trees, of which the early ones are in general feeble in their growth, and much more stunted and prone to decay than the late ones. There are exceptions among them, but this is the general law. We have proofs of the same in the case of many herbaceous plants. Thus, for instance, if the dahlia is planted in too rich soil, and where, along with heat, it has an abundant supply of humidity, it runs up to great size, but has very few flowers, and they are very late.

If a bulb or tuber is the store to be accumulated by the Summer action, whether for the production of a succession of plants, or for another year's growth of the individual, the same modes of treatment produce the same effects. If potatoes are grown on a soil too rich and humid, the tubers are few, long in coming, and never perfected. It is the same with the carrot and the turnip, and all the analogous plants, whether the principal store which they accumulate be more of the nature of pulpy bark, as it is in the carrot, or more of the nature of pith internal of the fibres, as it is in the turnip. If we wish to have the accumulation for the ensuing year the greatest possible in any of these plants, we must place them in soils so light and dry as to prevent the plants from running too much to leaves. Some of the wild plants offer us lessons in this way which are not unworthy of attending to, both as we may find practical advantage in acting upon the hints which they give us, and in their explaining the rationale of the matter. Some of the potentillas, which, as we remarked in a former place, have fusiform roots, like little parsnips, when on light and dry soils, where they put out small leaves, have merely fibrous roots on rich and damp soils, where the leaves are large. Some of the grasses too, which have fibrous roots in humid places, have the lower parts of the stems swelled into bulbs when they are removed to dry places, especially places so dry, and so much exposed to the heat of the Summer, as that they are likely to be burnt up before flowering. These are among the natural defences with which some of the plants arm themselves against the extreme of the Summer; and it may be considered a good practical rule to cultivate bulbous roots in those places where the native plants have a tendency to form bulbs.

Where the accumulation is made in the stem, as it is in the turnip and carrot, it cannot be regarded so much as a working for the species, as simply for the individual plant; but still, in all plants whose habit is to flower, there is a conservation of the power of flowering, even in the store which the plant appears at first sight to accumulate chiefly, if not solely, for itself as an individual. Those accumulations of pulpy matter on the stem, whether above the callet, as in the onion, or below it, as in the turnip and the carrot, always conduce to an earlier and more abundant flowering during the ensuing year; and that it is a defence against the drought is proved by the fact, that the flowering is superior if the bulbs are taken out of the ground and kept dry for some time. The same is proved by wet stagnant about them being more injurious to bulbs than any thing else; and hence the finer bulbs, which are planted before winter, always have a little sand put under them for drainage, unless the soil is very light and porous. The very same cause shows why bulbs should be rare in wet and dripping climates, and very abundant when the Summer is dry and parching.

When we force plants to form bulbs, by sowing the seeds so late that they cannot bloom the same year, we double the season of growth in the plant, though we cannot strictly be said to change it to a biennial. In the autumn of the first year, we perceive an accumulation of matter in it, which we convert in great part to some purpose in our economy. But the plant does not work for us, as it can have no purpose or intention one way or another. The grand function which the plant has to perform in nature is to flower, and perfect its seeds, and then die. We prevent this by our mode of treating it; and the energy which would have been exhausted in perfecting a limited number of seeds, is worked off in the formation of the bulk, which must be easier labour to the plant, as the accumulation of matter is often so very much greater. If we leave the plant alone, however, and if it does not rot in the winter, the whole of this bulb is expended in the flowering of the ensuing year. If we stop the plant in an earlier stage of its progress toward flowering we leave the surplus of its energy, not so much to any kind of accumulation, as to vigorous growth in the individual. Thus, if we keep a lawn closely cut, the grasses grow with great vigour, and fill the ground by tiltering at the roots, whereas, if we were to allow them to run up to seed, they would become thin and wiry, and would be invaded by other plants of less seemly appearance. The cereal grasses, which are our corn-plants by way of eminence, are all annuals, as we cultivate by annually sowing dried seed; but there is not much doubt, that by totally preventing their flowering they might be converted into plants of longer duration. That they were so before they were cultivated by man is probable, and the probability is strengthened by the fact, that few or none of them have been found in a state of nature; and those which have been found apparently so, have been in countries that have become comparatively desolate, after having once been peopled.

We had almost forgotten the grafted tree, though it has something to tell us about the Summer action. The stock is generally a more hardy and slow growing tree than the graft: thus it is more durable than a root of the stems which bears the fruit. This, however, is not the chief advantage; for the comparatively mere root, and the delicate portion grafted on it, alter the whole action of the tree, and give it more the character of Summer action. A tree of this kind, if prevented from putting out suckers below the graft, has comparatively little action of the root; and thus the greater part of its energies are directed to flowering and fruiting. All our common fruit-trees bear their fruit on the wood of the former year only; and of course the energy of fruiting tends as much to produce flowering shoots as flowers themselves; and by removing the portion which has once borne fruit, and will not of course do so again, and bringing in the fertile shoots in succession, the whole action of the tree may be changed to Summer action, and its leading and only valuable character may become that of being a fruit-tree. The extent to which this has been carried by the long and assiduous application of the results of experience, is far greater than those who never thought on the subject would suppose, and greater, indeed, than any, but those who have actually seen it, would believe; and it holds out a great inducement to study the rest of nature with the same experimental, constant, and persevering industry as has been exerted in this; and there is not the least doubt that the advantages would be correspondingly great in all.

The instances which we have given will help to point out what may be considered as the part of nature's action which especially belongs to the Summer. It is the connexion of generation and generation of all the tribes of living and growing nature in their succession. In every case there is a preparation made, and carried on so far by the elder generation,—as for instance the plant expands a flower, which is at once the most beautiful and the most transitory of all the productions of that part of nature. This goes on till the flower is expanded in all the beauty of its colours, and the richness of its perfume; and when the flower has performed its work, the petals drop off, and in proportion to the freedom and rapidity with which they are shed, is the perfection of the operation for which the flowers make their appearance. If they linger on the tree and wither there, the grand labour of the Summer has been in vain, in so far as the tree is concerned; if all goes well, they heal off, and fall before they fade.

The moment that they fall, there is a new life which begins to act for itself in the part of the flower which still remains, and which goes on to perfect the seed, and, in some particular cases, to make it germinate, before it peels off from the plant upon which it is produced. But this maturing and ripening of the seed, by the action of the new life in it, which, as we have said, is the final action of the part on which it is produced, is not the proper action of Summer, but of autumn.

In order to have a correct view of this most mysterious but most important part of the economy of nature,—and if we do not get a correct view of it, it is better to have none at all,—we must regard all that is done by the old plant, up to the full bloom and perfection of the flower, as Summer action, and all that is done by the young germ to its perfect ripening as a seed, as autumnal; and the grand action of Summer, the great mystery of living nature,—the *rationale* of which is above the utmost reach of our philosophy,—is the simple passage from the one of these to the other, which cannot be estimated in time, or by quantity of matter.

In the flower, or in different flowers on the same plant, or on different plants of the same species, there are different parts, the number and the arrangement of which forms the basis of the classification of plants, according to the system of the celebrated Linnæus. One set of these are in some way connected with the formal rudiments of the future seeds; we say "formal" rudiments, because as yet there is no principle of life in them, and if matters were to stop here, they would perish as untimely and unprofitable things. One of these is called a *pistil;* but the more correct name of it is *γυνη* (*gynia*)—"that which can bring forth or produce," not of any power or energy in itself singly, but by being adapted to obey the stimulating energy of another part of the same or a different flower, which has an organ that is called *stamen*, but of which the appropriate name is *ανδρος* (*antherus*)—"that which can stimulate to fertility."

Thus far all is a plain matter; and thus far is the preparation of the old plant, although, as has been already stated, it is an action which the same part of no plant can repeat a second time. But the mystery meets us here. There is a *γαμος*, or meeting, or contact, in which a certain substance, produced by the second of these sets of organs, and technically called *pollen,* (small dust,) which is, of course, saying nothing about its nature, stimulates the other kind of organ, and through that the "formal" rudiment of the seed, which from that instant is a formal rudiment no more, but the embryo of a new plant, in the mean time supported by the parent one, but perfectly distinct as a plant, and evolving all the future stages of its development by the life which is here begun; and, in so far as it is a life, perfected we cannot tell how.

When these parts are apparent, whether they are on the same plant or on different plants, the species is called a "flowering," or *Phenogamous* plant; and when not, it is called a "flowerless," or *Cryptogamous,* which means that the contact is seen in the one case, and concealed in the other,—though, to our understanding, the real *gamos* is always concealed. Making the requisite allowance for difference of organization, economy, and habits, something analogous to this in the general principle, appears to run through the whole of the living creation, animal and vegetable.

But it is every where a mystery; and, though it is not creation, it is the nearest approach to it that can be made: for it is the beginning of a new life, as *action,* the result not of matter, as substance, but of an *act* of matter; and thus no words can make it more plain. It is not the immediate finger of God, for it is the fulfilment of a law of nature as varied as the races of being; but it is one between which, and the more mighty mystery of original creation, there is not a single point upon which even the fancy can rest.

Other than it, however, there needs no proof of the being of an Almighty Creator; for it clearly proves that mere matter, as such, cannot originate *the life* of the very humblest weed. It is for this, the mightiest work in material nature, that all the beauty and the activity of the Summer are called forth; and but for this, the wedding garment of nature would be put on, and the nuptial song by ten thousand voices chanted—in vain,—or as the weeds of woe, and the dirge of death.

CHAPTER IV.

PREPARATION OF NATURE FOR SUMMER ACTION.

The extent to which those beautiful allegoric lessons of practical wisdom, which were delivered by our Saviour during his sojourn upon earth, go in all matters which relate to our own conduct, and to the course and conduct of nature around us, is truly wonderful. They are so universal in their application, that this alone, without any other of the additional proofs which stand in countless array, might fully establish, to any unbiassed and contemplative mind, the divine nature and mission of Him by whom they were delivered; for truly, as is observed by the Apostle, "He spake as never man spake."

Of these allegorical lessons, two of the most easy application, and at the same time most pertinent to our present purpose are, the parable of the ten virgins, and that of the king who prepared a feast, to celebrate the nuptials of his son. In the first of these parables, the foolish virgins had "lamps," as well as the wise ones; but they had, "no oil," and did not "trim" their lamps; therefore, when they sought admission to enjoy the feast, the bridegroom dismissed them, saying, "I know you not." So also, when the man who had not on a "wedding garment," was detected at the marriage feast, the king said to the servants, "Bind him hand and foot, and take him away, and cast him into outer darkness."

The grand application of both these parables is no doubt of a spiritual nature, and meant as a warning against the vain hope of partaking the "light of glory" without the "oil of grace," and the vain self-sufficiency which seeks for pardon and acceptance in the sight of God in the spotted covering of human virtue, instead of approaching that solemn audit, clothed in the spotless robe of "the righteousness of Christ;" and in this way the instruction with which both parables are fraught is most important in its nature, and most ample in its range.

But every lesson which has come to us by the inspiration of God, has this superiority over the lessons of merely human wisdom, even as they are given by the wisest and best of the human race, that it is perfectly general; and besides its primary and spiritual application, it applies to all men in all ages, and to every point of the system of nature, in all its kingdoms, and in all their numbers, phenomena, and successions. Human instruction is often very good and very useful in its particular subject, and be it what it may we invariably find, that after we have gone only a little way from the subject to which the lesson had more primary reference, it breaks down with us, and leaves us as much at a loss as we were at the beginning. Indeed, it is often worse than this; for, if we may so speak, it leads us out into the wilderness, and leaves us there, alike uncertain how to proceed and how to return; and the fact of its doing so, is the cause of very many of those errors with which every human system abounds, and which are unavoidable in every case in which there is not a direct application at every step,—and in many cases where there is, for the sense is as frail and limited in its peculiar sphere, as the mind is when unaided by the light of divine truth. With the divine precept, whatever may be the words of that precept, the case is widely different—diametrically opposite, as we may say. At first it may seem to be but dimly instructive, or even not instructive at all. This, however, is occasioned by our limited powers; and, like the extent of the ocean, when we stand upon the shore, it is hidden from us in its own immensity. It is "as high as heaven; what canst thou do? deeper than hell, what canst thou know? The measure thereof is longer than the earth, and broader than the sea." It comes clothed with divinity, and demonstrates the majesty of God at the same time that it declares the counsel of his holy will. But if we receive it in the proper manner, and take it as the foundation of our judgment, and the rule of our life; then the blessing of Him who sent it is upon it, and it brightens the eye, and sinews the arm, and thus, though we wist not what to do with it at the beginning, we soon find that in every thing it is not only useful but indispensable.

The general lesson inculcated in the two parables to which we have alluded is this: *We can neither know* *nor do in the proper manner, if we attempt either the one or the other without due preparation.* When stated in so many words, this appears so very simple as to be self-evident; and yet, every time that we err, whether in thought or in action, without being actuated by vicious intentions, the neglect of that simple maxim is invariably the cause. On the other hand, when we come with due preparation, either to seek knowledge or to perform action, we invariably succeed. The two parables equally set forth the maxim, and the importance of it may be inferred from it being twice put by our Saviour, in that peculiar mode of language which is more easily remembered than any other. The man who had not on the wedding garment is, however, most descriptive of those who attempt to obtain knowledge without due preparation. The sentence against him was, to "bind him hand and foot, and take him away, and cast him into outer darkness;" and it is added, "there shall be weeping and gnashing of teeth." The subjects of our knowledge are servants of the Almighty and Eternal King, to minister to our comforts, if we come clothed in our minds with the "wedding garment" of due preparatory knowledge; but if we venture to approach them unprepared, they bind our understandings hand and foot, and cast us into the utter darkness of ignorance and error; and all nature stands witness to the truth of revelation in this.

The reader cannot have failed to remark that, in both of the parables, the invitation, for the due acceptance of which the preparation was indisputably necessary, was to the "MARRIAGE FEAST." We have already shown that the proper function of Summer is the nuptials of growing and living matter, at what time, or in what manner soever, that may take place in any particular region, or for any particular species. Therefore, if we do not come to the contemplation of this, duly prepared with knowledge of the substances, the agencies, and the laws of action, we shall be cast into utter darkness, and lose all the enjoyments of that feast, which the God of nature has in an especial manner prepared for us, for mental improvement and for bodily comfort.

There is something still to be drawn from this parable. We may come to this feast unprepared, or we may refuse to come. Our doom in the first of these cases has been adverted to; and these are the consequences,—we are cast into utter darkness, and there shall be weeping and gnashing of teeth: we had the desire and the opportunity of knowing, but we neglected the means; the opportunity has gone never to return; and while we might have secured the means of eternal enjoyment, we have nothing before us but an eternity of despair! Well may there be "weeping and gnashing of teeth!"

If we "refuse to come," it will fare differently with us, but not better. Those who were first invited—and the invitation set forth all the richness of the feast—"refused to come, and entreated the servants spitefully, and slew them;" and so refusing, and so acting, the King "destroyed them, and burned up their city." When we confine ourselves to the mere routine of "the farm and the merchandise," and neglect the knowledge of those things and occurrences, whose history the Almighty has written in the book of nature for our instruction, we may be said eventually to "entreat spitefully," and to slay those servants of the King of nature, which he has sent especially to invite us to the feast, and tell us how abundant and how ready it is; and, therefore, putting the reality for the allegory, this punishment will be our punishment,—we shall die in our ignorance, and our memories shall perish like those of the beasts.

Such are the consequences of coming to the observation of nature, or of seeking the improvement of art in the study of nature, without due preparation; and such also are those of neglecting that observation altogether. "The farm and the merchandise" may be portion enough to men of narrow and unexpanded minds, who content themselves in the congenial society and emulation of manure-heaps and mines; but when the lustreless eye is closing upon these, the idols of their sordid admiration, what will be their portion then? Well may the vacant spirit expostulate with the last enemy, "Thou hast taken away my gods, and what have I left!" These are the perils; but the encouragements to the proper course, even leaving the eternal consequences out of the estimate, are more numerous, and far more delightful to be dwelt upon. The servants that are sent to invite us to this grand marriage feast of living and growing nature, are many and varied, and many of them come from afar.

In the first place, the earth itself runs, in its orbital course, from the winter solstice in December to the

Summer solstice in June, not much less a course in absolute space than three hundred millions of miles. This, it is true, is not the immediate or proximate cause of any thing seasonal upon it; but, as it belongs to the earth as a body, and as the most conspicuous action of the earth resolves itself into that of the vegetables and the animals, we may consider that it has a reference to them, though it is a reference the particulars of which we cannot state. There is another motion of the earth combined with this in the determining of its absolute path, of which the effects are directly seasonal, and which may, in fact, be said to be the grand cause of the seasons in all their phenomena. This is the counterpart and real cause of the apparent motion of the sun in declination; and, though it is not uniform, being slow immediately after the winter solstice, increasing at an accelerated rate toward the spring equinox, and again decreasing as the Summer solstice is approached, this motion of the earth, though performed during the time that it is advancing nearly three hundred millions of miles in its orbital progress, is performed in the direction of the axis of rotation. The axis, with the exception of some periodical vibrations, which are much too small for having any seasonal effect, maintains its parallelism during the whole of this long journey; but in the course of the half year, it shifts "end on," as one may say, no less than about seventy millions of miles in absolute space, being twice the sine of twenty-three degrees twenty-eight minutes,—half the transverse diameter, or principal axis of the earth's orbit, being radius. Perhaps this may be better understood by those who are not conversant with astronomy, if we say that, imagining a perfectly level plane to pass through the position of the earth in the equinoxes; and that the position of the north pole is downward, and the axis, when the earth is in these points, at right angles to the plane; then, at the winter solstice, the earth is about thirty-five millions of miles below the plane; thus it comes up to the plane at the vernal equinox, and rises to about thirty-five millions of miles when the midsummer solstice is arrived at;—it is quite evident, that besides the orbital motion referable to the equinoxial plane, the earth has passed from thirty-five millions of miles below that plane, to thirty-five millions of miles above it, which makes seventy millions of miles in the whole. This motion is not, as we have said, uniform; but if we average it, it is at the rate of about four hundred and forty-five thousand miles in the day, or more than eighteen thousand miles in the hour; and this very rapid motion is what the earth, considered merely as a mass of matter, and without any reference to the substances of which it is composed, the plants with which it is clothed, or the animals by which it is inhabited, contributes as its quota of preparation for the Summer action, the grand nuptials of living and growing nature. As illustrative of the rate of variation in this motion at different periods of the half year, we may mention, that it is only about seven thousand five hundred miles in the day, at the solstices where it begins and ends for the half year; while at the time of the equinox it is about five hundred and fifty thousand miles a day, which is more than seven times its velocity at the solstices. When any cause is more energetic or powerful in its action, it not only produces a greater effect upon the whole, but that effect takes place sooner in time, as the more powerful cause more speedily overcomes the resistance of inertia which is opposed to it. Thus, the preparation for the Summer, arising from the oblique motion of the earth in its orbit, is gentle and gradual when it first arouses nature out of the repose of the winter, becomes more and more vigorous as the time at which heat gains the dominion is approached, and afterwards slackens gradually, in order to allow the functions of Summer to be performed without any disturbing influence, even by that power by which the energies of growth and life are worked into strength for the performing of their Summer action.

This, which, being the preparation of the whole earth, without any respect to particular surfaces or productions, must be regarded as the first and grand preparation of nature for the function of the Summer, is performed without any known resistance or opposition, and therefore it is not, in our common notions of things, productive of any wear or exhaustion. Always balanced, to the very smallest fraction of a grain, between the orbital force of its own motion, and the gravitating influence of the sun, and having no function or after hinderance in its career through space, the earth moves onward, perfectly unaffected and not wasted or wearied in one grain of its substance, although its velocity is such, that a chariot of ice moving at the same rate along the ground, would absolutely be set on fire. Thus, though the earth is the grand means of preparing all its productions and inhabitants for their Summer action, it consumes no part of the result of that action, nor is considered, as a whole, in the least consumed or affected by it. Every thing upon the earth is therefore left perfectly free to the operation of its own law; and the earth itself merely brings, by the change of the position of its axis, the increase of solar action, in which all upon the earth may freely share according to their several natures and degrees. The slight diminution which has taken place in the obliquity of the earth's orbit, may have made the Summer a little less ardent, and the winter a little less severe; but at most this cannot exceed a thousandth part of the difference counted upon both, which is of course only a two-thousandth part upon each; and this is too small for telling, so as to be perceived by us, even upon the most delicate plant, or the most sensitive animal.

The whole terrestrial economy is thus left to its own nature and working, and plants may spring up, flourish, fade, and wither; animals may be produced, and live, and die; countries may change by nature, or be changed by art; and islands and continents may be exhausted and replaced: all these may happen again and again, till the line of figures which attempts to express their numbers, shall lengthen beyond the field of our vision. But amid all these changes, the preparation by the earth for the Summer remains the same—unaffected by any of the minor movements of its individual parts, and secure in the keeping of Him, who thus declares of himself to all who have ears to hear, and hearts to understand—"Hearken unto me, O Jacob and Israel my called; I am He: I am the *first;* I also am the *last.* Mine hand also hath laid the foundations of the earth, and my right hand hath spanned the heavens: I call unto them, they stand up together."

The preparations of nature on the surface of the earth, for the action of Summer, are so many and so varied, that the details of them are absolutely interminable, and therefore incapable of popular enumeration, far less description. They may, however, be generalized under five heads, at each of which we may take a rapid glance, in order that the reader may have some slight means of connecting his individual observations. Four of these evidently are,--the preparation of the atmosphere; of the land, considered merely as surface; of the water; of the plants; and of the animals: and, as we have already considered the preparation of the earth as a whole, the first of these four will be our second in enumeration.

In the second place, then, there is a preparation of the atmosphere. As this fluid circulates truly round the earth, the preparation may be described as extending to the whole of it; and in this way it has the advantage of the waxing influence in the hemisphere where it is Summer, and the waning influence in the opposite one. The result is a transfer of the atmosphere on the surface to the Summer hemisphere, and a return of the upper atmosphere to the winter one; but in general this is so slow and gentle that it is concealed from our observation by the operation of local causes, so that we can only notice the change in the atmosphere at the place of observation. Increase of temperature is the general preparation of the atmosphere, and the first of the secondary results is an increase of the evaporative power. At the commencement of the annual action, this is chiefly occupied in drying the ground after the rains or snows of winter; and it is well for growing and living nature that it is so occupied; for, if it were not, it would speedily so crush and harden the still comparatively naked surface, as that not a vegetable could spring up, and the destruction of the vegetables would, as a matter of course, involve that of animals.

Thus occupied in great part in drying the ground, it allows the seeds, roots, and buds to work until they have brought the leaves of the Summer plants to their full expansion, so as to clothe the fields and the woods in their green livery. This livery shades the earth from the ardour of the sun, and draws that action upon itself, where, for the grand purpose of the year, it is more immediately wanted.

The leaf, the frond, or whatever else it may be—the green expansion, is one of the most active parts of the plant, whether in promoting the growth of the individual, or in preparing for the flower and seed, or the other means of succession, whatever these means may be. All plants give out a great deal of moisture by evaporation; otherwise the parts of them would not consolidate, and they would remain gelatinous, like those plants which grow under water. But the evaporation, chiefly that from the leaves, enables them to consolidate their structure, and it in time so hardens the vessels, that they are no longer flexible enough for allowing the fluid to excite the buds to further extension; and then, of course, the annual enlargement of the plant is suspended and gradually luxuriates for the year.

May is certainly, at least in our islands, the grand month for the action of leaves. No doubt there are some plants of the early spring which have died down, and are not to be seen; and there are other late ones, which have "barely, if at all," come into action; but if we take a rough average of the whole, May is, by way of eminence, the leaf month; and, in the southern and warmer parts of England, May is the month of greatest evaporation, and also of least rain.

What has been stated on this second department of the preparations for Summer, has much reference to the vegetable kingdom; but, as the preparation of this is, in a great measure, the result of the change of the atmosphere, the one cannot be perfectly understood unless the other is taken into consideration along with it. But we may now advert briefly to that preparation which may be said to be made more exclusively in the atmosphere itself. One necessary effect of the increased heat of the air, is to raise higher above the mean level of the sun the line of congelation, or height at and above which water cannot exist, *in quantity*, in the liquid state. We say "in quantity," because it is possible that a small portion of water may remain unfrozen in the air, in the state of invisible vapour, even when the temperature is below that of freezing; but a rain cloud cannot be so formed as to fall in drops at an elevation of this kind. The result of the elevation of this line of congelation, is a corresponding elevation of the region of clouds, and of atmospheric disturbance generally, and the consequent interposition of a stratum of dry air between this region of clouds and the earth. The height of this stratum, or the separation of the clouds from the earth, arises with the latitude and character of the surface; and the time of the year at which, according to the Kalendar, it becomes established, will also depend upon them. Thus, in the highest latitudes of the Greenland seas, to which ships resort for the northern whale fishing, the vapour seen can get so high as to form a rain cloud, from which drops of any size can fall. In these dreary regions there are abundance of fogs, and, among the fields and floes of ice, there are snow showers at intervals nearly all the season through. But both are confined to a comparatively small height in the atmosphere; and the more rain falls in any state having the least resemblance to hail, there is enough to show that there is some degree of Summer atmosphere there, however limited it may be in height; and accordingly, the rocks of Spitzbergen themselves are not wholly without Summer growth and life.

As we proceed southward, the stratum of air, affected by the Summer drought, becomes of greater thickness, and the region of vapours is removed to a greater height above the surface of the earth—to such a height, indeed, as that the connexion between that region and the earth is much intercepted or wholly broken. The rains that do fall, generally fall in very large drops, which shows the great height from which they come; and the very last which descend in April, or the early part of May, may often descend in hail, the hailstones being larger in proportion as they fall in places more to the south; which is evidence that the height from which they come is still greater. These are not unfrequently accompanied by lightning and thunder, though much more rarely in the northern parts; and the accompaniments are not so violent as they are when the weather begins to break after the Summer drought, because at that advanced period the dry air which separates the region of clouds from the earth, has attained its greatest height. This period of greatest Summer drought, which takes place sooner or later, according to circumstances, but generally in May and June, may be regarded as the time that puts an end to the spring action, or enlargement of the individual plant, and allows the proper function of the Summer to be exercised.

Within limits which have a considerable range, it must be regarded as a period of the most valuable kind; but the degree and duration of it may be either deficient or in excess. If it is deficient, then there is a superabundant production of vegetable substance in leaf, in stem, in shoot, and in new layer of wood, and in every thing else that tends to enlarge the plant in its individual structure; but the quality is soft and inferior, and there is a deficiency of flowers and fruit. Under such circumstances there is an abundant supply of green vegetable food for domestic animals; but it is tasteless and inferior, containing less nutriment than would have been obtained from a smaller quantity, if the preparation of the atmosphere for the Summer had been less kindly. On very dry soils such a season may be advantageous; but it is an advantage gained by the inferior parts of the country at an expense to the more valuable ones. If, on the other hand, the preparation of the atmosphere for Summer action be in excess, evils of an opposite kind, though no less disastrous, may be the result. The herbage upon the dry grounds is burnt up; the corn is prematurely checked in its growth, the ear being often choked and arrested in the sheath; and the trees are assailed in leaf, in bud, in tender shoot, and in the cambium between the wood and the bark, by countless myriads of insect spoilers. The reason of the burning up of the herbage, and that of the choking of the ear in the sheath are easily seen; and it is not difficult to understand why the insects should be most destructive in such seasons. In average years, the preparation of the atmosphere and of the plant proceed at the same rate, and so work harmoniously together; and by the time that the action of the heat begins to construct the vessels, and turn the action of the plant to flowering, to the maturity of fruit, or to the ripening of wood, as the case may be, the annual supply of sap in the trees is nearly all applied to its preparation. But when the drought comes early and severe, so as to constrict the vessels, and check the growth while yet the sap is in the full flow of its abundance, the activity of the healthy sap goes off, and it acquires a saccharine taste. The drought is favourable to the hatching of the eggs of the insects, and the saccharine taste renders the juices of the plant the most desirable food which the larvæ can obtain: and, from both these causes acting together, they come in swarms, and with a power of destruction which no effort of man can resist. It is not that there are more germs of insects in these years than in others; for in any year, a single copse probably contains the eggs of as many insects as, if they were brought to maturity, would be sufficient to destroy a county: but when growth is vigorous they do not come to maturity; and thus, when a season favourable for them does come, ignorance and superstition set them down as some mysterious production of the year, out of the common and only course of generation.

The smaller plants are affected by this drought in their whole structure, in the root below ground, as well as in the parts above. The larvæ of the ground beetles attack the roots of both grass and corn, in countless multitudes; and the ravages which they commit on the former are often so great, that whole rods of the surface, still bound together by the withering remains of the grass, may be rolled off like a carpet.

These insect depredators are a sad pest to man in his artificial dealing with the ground: are they so in wild nature? That can hardly be; for, whatever the seasonal and temporary effects are, we are bound to believe that all the powers of wild nature work for good in the system, whether they happen to do the same, or the reverse, for man's artificial operations. The subject has not been investigated with that attention which its importance demands, and it is not one of easy investigation; but we believe it has been pretty generally observed, that the year succeeding one remarkable for this insect spoliation is generally a year of abundance.

The shrivelled and unhealthy leaf, remaining on the tree, and dying there without healing off, appears to communicate unhealthiness to the whole; and therefore the dropping of leaves of this kind appears to be a means of preservation. The subjeet is an obscure one, however, and nothing very positive can be stated respecting it.

Such are the effects of both under and of over preparation in the atmosphere for the action of Summer. Man has in some measure his relief against both; under-drainage, in the ease of too little aetion, and in the case of excess, shading houses aecumulations of water, such as have been attended to in a former chapter of this volume; and which are also the means whereby land may be won back to fertility, from the dominion of the thirsty deserts, if that dominion is not too much confirmed before the means of recovery are applied. In short, man is to work against the season of deficient atmospherie preparation, as he would work against the marsh; and, in the case of too much, he is to work as he would work against the dry and parehed moor. There are some parts of the eountry, in whieh, marsh and moor alternating with each other, oecupy no inconsiderable portion of the surfaee, the people embody the semblance of both of these remedies, withont perhaps being aware that there is any lesson of praetical wisdom in what they say. Their saying, when, in a dripping season, they see the ground-fogs creeping up the slope from the marsh, is, that "the marsh is invading the moor;" while, in long-protracted dronghts, when the marsh consolidates without any visible fog or vapour ascending from it, they say that the moor is draining the marsh. From this part of the subject there are many lessons which might be learned; but our limits will not allow us to pursue it further.

There is still one point connected with the preparation of the atmosphere for the action of Summer, which we must notice: and that is the general use of that separation of the region of clouds from the surface of the earth, which takes place at this season. The direct tendency of this separation is to leave the surface of the earth, with all upon it, to its own particular action. At other seasons there is an extended connexion between country and country, so that Lapland, and the tropical parts of America, may by turns show their effects, (mitigated by the journey, of course,) upon any land intermediate between them. But when Summer is preparing for all these general intercourses of country with country, in so far as they are carried on, they are carried on in the upper regions of the atmosphere, and do not reach the surface of the earth. In winter, and also in early spring or late autumn, the same gale may sweep over the whole of such a country as Britain; and the same snow or rain may come and deluge it from the one end to the other. But in Summer these disturbances are very limited, and very local. There may be many kinds of weather at the same moment in one county, or even in one parish; and if one watches a hay-field of considerable extent, in a day chequered with sunshine and thunder, (which, by the way, is one of the most pleasing sights in nature,) there may be fifty different winds sporting upon it in the course of as many minutes, and all of them apparently originating and expiring within its limits. In walking or riding for only a few miles along a road, one may be annoyed by dust. (It would be well to adopt the Scotch word *stoor*, which means dust in motion,—for which there is no single, and therefore no striking term in the English language). At one place there may be a perfect annoyance of dust, coating the hedges and contaminating the whole vegetation; and before one has advanced above a mile or two, the road may be ploughed into water-courses, and the whole vegetation refreshed and glistening with "the clear shining after rain." In mountainous countries the transitions are still more rapid and striking: a hundred yards may bring one from the burning sunshine to a shower which will wet to the skin in a few minutes, and yet the sun, though softened in its influence, will still be visible; and one will be completely at a loss to find out whence this drenching has come. So also, one may travel for great part of the day under a cloudless sky, and with the remains of the streams hidden under the pebbles, so that the channel resembles a loosely paved road; and yet, upon coming to streams which have their sources on the other side of the summits that limit the view, one may find them swollen to the majesty of rivers, and red and roaring, so as not to be fordable without a good deal of hardihood, and some danger. There are still more striking instances than these, of the very limited range of Summer action, even where it is rather violent. There is one mountain stream in Scotland, (the Oran, we believe,) which comes from very rugged mountains, and descends a long bleak slope, till it joins the Conon, a larger, and at that place a more tranquil river, in a very wide channel of large stones and shingle, which have been carried down by the violence of the floods. "Dry at entering, a flood at mid-channel, and dry again on quitting," is a common saying of the ford of this stream; and from the tops of the hills the flood may be seen moving onward like a miniature sea, with the stream hardly visible, either in the front of it or in the rear.

The more marked and violent cases of Summer action in the local atmosphere, does not of course take place until the general action is wholly suspended, the preparation complete, and the Summer far advanced. But still, as they are among the most striking atmospheric phenomena of the season, they lead us to understand the nature of the local action, which takes place in a less turbulent manner. By means of that action field tells upon field, copse and wood upon ground, and all places on each other, so as to distribute the benefit of the season in a very beautiful manner. If there is too much moisture in the locality of a flower, for enabling it to display the full tints of its petals, to elaborate the honey in its nectary, to bring up the heat necessary for maturing and discharging the fertilizing pollen, or for giving out the odour which appears to attract the bee to the performance of that labour of promoting fertilization, for which the honey of the flower seems to be its wages,—then the silent messenger comes from the parched and thirsty place, and fetches it away, so that it may help to sustain the drooping flower there, and save two of nature's children by one single act. Every one who has observed at all,—and they who will not observe nature, are unworthy of their place in nature, and should betake themselves to the mine of their golden idol, and dwell with sulphur, and mercury, and arsenic, and all the pestilencies of the pit,—every one who has observed at all, must have remarked with what beauty the flowers expand, and with what incense they make the air to delight the nostril, when they are placed under the shelter of a brick wall facing the east; and also, when the season is further advanced, how the peach blushes in the softness of its down, and the plum and the grape bloom like Eden. A soil which can sustain this extreme perfection of nature's working, is of course required in such places; but then the perfect delivery up of the atmosphere to local causes, enables the wall to abstract and carry off every particle of moisture that would be a bar in the way; and so the native of more sunny skies finds an Italy in England; and if man founds his art upon proper knowledge, the *ultima Thule* itself blossoms and glows with sweets, unknown to it without the results of science. This preparation of the atmosphere for the Summer, and the delightful advantages to which man can turn it, by the help of a little—a very little knowledge, are subjects upon which one could dwell with pleasure, for more hours and days than arithmetic could easily sum up. But ours is only a passing glance,—an attempt to rouse the mind to that in which it may, and with small effort must, find its own gratification, and add knowledge to knowledge, and enjoyment to enjoyment, till nothing but heaven itself, and the full fruition of knowledge, which God has graciously promised to those who, in sincerity and simplicity of heart, seek it in the right manner, according to the word of his revelation, are sure to obtain.

In the third place, we have to notice the preparation for Summer action of the earth itself, considered chiefly as surface exposed to the influence of the sun. This will not detain us long; because in all cases that can come fully and completely under our notice, the surface of the earth, and as far below that surface as seasonal action may be supposed to penetrate, considered as mere matter, is little else than passive. The depth to which the action of the sun, as a healing cause, penetrates the earth, is much smaller than any one would be led to suppose. There is no difference of temperature in a deep mine, summer or winter; and, to the feelings, though not to the thermometer, it appears warmer in winter than in summer. It is much the same with a deep-seated spring, although the depth is not very great. In districts which have great variety of seasons, the water of such a spring will, during the intensity of the Summer heat, feel as cold as iced water; and nobody who has not tried the experiment would believe how delightfully refreshing the atmosphere over it is. Many years ago I was well acquainted with one which came boiling up in an area of about ten feet in diameter, under the south wall of an ancient place of sepulture, and with a discharge of water unabated in the drought, and unaugmented in the rain, which would have sufficed to turn an ordinary corn-mill all the year round. It came up from almost countless apertures, over which the pure white sand danced very beautifully in the transparent water: and the well-head was spotted with several hassocks of the richest evergreen verdure. To stand over the "welling" water upon two of these, on a hot Summer's day, was as delightfully refreshing as it is to go and meet the sea, when, in nameless beauty, it gurgles and ripples to its height of tide on a beach of the purest sand. Then, in winter, a snow-storm of two months' continuance was unable to subdue this rustic spring. The current from it flowed smoking, until it met the rivulet which came from less pure and deep sources, and was of course more affected by seasonal changes. The apparent smoke was of course the conversion of the vapour into small spiculæ of ice, when it got to such a distance into the cold atmosphere, as that it could no longer be sustained in the state of invisible vapour; and the more keen the cold of the surrounding atmosphere, the greater, of course, was the appearance of smoke over this spring and its stream; and when the hand from the atmosphere was dipt into it, the water, of course, felt the warmer the colder that the atmosphere was. From the situation of the places whence this spring could derive its supply of water, it could not be any where more than fifty or sixty feet under the surface of the earth; and yet this was quite sufficient to maintain a perfect uniformity of heat at all seasons, though the seasons ran in what may be considered extremes for the latitude. The half of this depth does not, however, appear to be necessary for perfectly equalizing the temperature of the interior at all seasons. We know the limited depth at which an ice-house, or even an ice-cellar, in a city abounding with every kind of artificial heat, in addition to the natural heat of the warm season, will retain the temperature of freezing all the year round. We have still more striking instances brought about by natural causes, in some parts of North America, where the cold and warm seasons run into much greater extremes than they do in any part of Europe. The rivers which flow into the polar sea in that part of the world, often cover large masses of snow and ice with sand and mud, upon which vegetation comes in the ensuing season, while the snow or ice remains permanently below, unaffected by the heat of the Summer, and unaffecting the Summer productions.

There have been many theories, and most if not all of them very vague and visionary ones, about the internal heat of the earth. But the depth to which snow is able to penetrate is so trifling, that none of them can be said to be matter of rational philosophy; and if we wish to understand the earth as it is,—the subject of rational observation and reflection,—we must put them altogether aside, and look only to that which comes regularly within the scope of our observation.

The action of heat, as originating in or produced by the sun, is the subject which comes within the scope of our observation and reasoning, when we attempt to understand the seasons; and we may with perfect truth say, that no part of this remains as a permanent action upon the earth, or one that accumulates or becomes greater, in the course of years, in any sort of influence upon the mass of the earth.

Heat, we must clearly understand, is not substance, any more than the motion of the earth in its orbit or upon its axis is *substance*, or that the life of an animal or the growth of a plant is substance; it is *action*, and nothing but action.

This being understood,—and it is the only understanding that will agree with the facts of the case,—we can easily see that heat cannot be treasured up in a storehouse, in the same way that we treasure up any thing that is substance. We can restrain its action just as we can restrain many other kinds of action; but if we take off the restraint, the heat is gone, and we seek for it in vain.

The heat, and whatever other energy may accompany the heat in the beams of the sun, comes to us as a working power, seasonally modified by the changing positions of the earth's axis with regard to the sun; and there are various causes which cooperate with each other in keeping this influence near the surface of the earth, as well as in the proper distribution of it to the different parts of that surface. As the atmosphere is the more immediate agent in the distribution of heat from one part of the surface to another, water is the chief one in preventing its action from penetrating so deep into the substance, as to be lost to surface action. Every one must be aware of the difficulty with which heat can be made to penetrate downwards through water; and also, that if the surface of water is freely exposed to the air, and can rise in steam or vapour, carrying the action of heat along with it, and absorbing or consuming it in the separation of the particles of water, its temperature never rises over the boiling point, or 212° of the common thermometer at the mean pressure of the air; a little lower, when the pressure is less than the average, and a little higher when it is greater.

But there are general properties of water, depending on its very nature, and not in any way on the quantity in which it may exist at any one place, excepting that a small quantity is, as one might naturally suppose, more speedily heated or turned into vapour than a large quantity. Hence we can readily see that water, mixed with the solid substances that compose the soil, or surface matter of the earth, must obey the very same laws as water on the surface, in whatever quantity it may be accumulated there, whether in a little pool, a great lake, or an ocean. The air has access to it every where; for air penetrates not only into the pores of the earth, but into the substance of water, in which our nicest observation can find no pore.

Of the solid matters which compose the *soil* of the earth, charcoal exists in considerable quantity in all of them which contain much vegetable matter, for charcoal may be regarded as the substantive parts of all those portions of vegetables which are not decomposed by the action of the sun, the air, and the water. Now this charcoal is also a very bad conductor of heat,—so much so, that it is very often used in the arts, for confining the action of heat to the cylinders of steam engines and other vessels, in which the action of heat is required, and where it is desirable to obtain it with as little waste as possible. Charcoal, whether the other substances with which it is mingled in the living vegetable have been separated from it by actual combustion, or by the more slow and moderate process of simple decomposition, is therefore to be considered as the substance which, next to water, most powerfully operates in preventing the action of heat from penetrating into the ground, and being dissipated there. Indeed, in what may be called its passive resistance, as merely opposing the progress of the heat, it is probably superior to water; but it has none of the "active" resistance, that is, no power of carrying off the heat by evaporation, for it is one of the least decomposable of all substances, at least by the ordinary agencies which carry on all the surface operations of the earth, at whatever season they may be carried on. Pure charcoal would, therefore, be as bad a soil for the growth of plants as could well be imagined, though there can be no doubt that a portion of it, in that state of extreme division and intimate moisture which results from the natural decay of vegetables, is highly useful.

Charcoal and water, which are thus the substances which resist most powerfully the passage of the solar heat into the substance of the earth, are both combustible, that is, resolvable into airs or gases: the first by union with oxygen, in which state it becomes carbonic acid; and, as carbonic acid, it is one of the most abundant waste-products, both of animal and of vegetable action; and the other, by the direct separation of the hydrogen and oxygen, of which it is, when pure, wholly composed. Thus, besides contributing more powerfully than any others to the keeping of the solar action at the surface, where it is chiefly useful in the operations of the seasons, water and charcoal perform very important functions in the economy of both animals and vegetables. These functions appear to be analogous to those operations which we call chemical, but they cannot be explained by any analogy drawn from our experimental chemistry, because, in our experiments, and also in the chemical operations that we observe in wild nature, of which our experiments are imperfect imitations, there is wanting a most important element, which is always preserved in the animal and the vegetable. This is animal or vegetable life; not matter, but the power of moulding matter according to a certain specific type, created at the first, and capable of being afterwards transmitted from generation to generation, as long as the perfection of the system and the pleasure of the Creator may require it to work—a period the length of which is, of course, not written in the book of our knowledge. In what manner this principle of life alters the chemical action of substances from what it would be if there were no life in the case, we cannot know; but we can readily understand, that a power which is capable of organizing a plant or an animal, out of matter, and maintaining that organization in the performance of its functions for the stipulated time, must exert a very great influence upon every operation in which that plant or that animal bears a part.

This is one of the many instances which we find,—

and which we cannot contemplate any one part of nature without finding,—of the wonderful simplicity and general application of those laws by which the Almighty governs all his works. Charcoal is the indestructive ingredient of all animal substances, as well as of all vegetable ones; for, though the bones, crusts, and shells of animals, and the stems of the corals, and of many of the other polypi are, in great part, composed of salts of lime, yet, though these are animal formations, they cannot, in so far as the salts of lime are concerned, be called animal substances, or even organized substances. In themselves, they perform not a single function of life, or even of growth; for the additions which are made to them are mere deposits of matter, which is elaborated and supplied by other organs; and, considered in the mere lime that it contains, there is no more of the principle of growth or of life in a bone or a shell, than there is in a limestone. Nay, in the case of bones at least, especially those of the mammalia, the death of the animal, in the progress of natural decay, appears to begin in the parts which elaborate and deposit these salts of lime; and it appears also to be this which limits the growth of the animal to a certain size. In plants there are no salts of lime; but some plants, chiefly of the family of the grasses, deposit *silica,* or flint earth, on the epidermis, and sometimes in the hollows of the stems, as, for instance, the *tabasheer*, in those of the bamboo, which, however, does not appear to have any vegetable function. It refracts light less than any other substance, however, and the coating of it upon the culms or stems of the grasses may lessen the solar action, and thereby promote the early ripening and drying of the stem, for which plants of this family are so remarkable. The absolute refractive power of tabasheer is little more than one-fifth of that of air, about one-eighth of that of water, and one-fifteenth of that of pure charcoal, in a crystallized state; and, though the refraction of heat is not quite so great as the average refraction, yet it follows the same law of variation. It will be borne in mind, that refraction is always a turning of the sun-beam into the substance; and this being understood, it will readily be seen, that an epidermis containing flint must be less disposed to admit the action of the sun than any other.

We are thus to consider that water and charcoal are the substantive parts of vegetable and animal substances, and they are the most abundant—the water being either in substance, or in elementary gases; and they are the grand instruments in keeping the heat of the sun near the surface, when it is most useful to vegetables and to animals, either directly or through the medium of the vegetables.

Such are a few points in the more simple part of that knowledge which we would require to bring with us, in order to understand how and by what means the earth is prepared for bearing its part in the grand action of the year. The other elements which we would need for the full investigation are exceedingly numerous; and so little have they been attended to with this view, that they can hardly be said to be within the scope of science. Those who treat professionally of soils, and their influence upon the growth of plants, do not come to any very harmonious or sage conclusions as to the influence of soils properly so called—that is, of mineral substances in a state of disintegration, and mingled with the remains of organic ones; and when they come to the subsoils, they very generally slur them over as "not appearing to have very much influence in the matter;" which may be, and is, perfectly true, in as far as human knowledge at present extends, or may extend, for many years and ages to come. We must be careful, however, not to limit the real ore in nature by our knowledge of it; for we may rest assured, that there is not one useless production or substance in the whole; but, whether in their larger masses, or in their disintegrated state, in which they form part of the soil, there is not on earth a metal or any other mineral substance, by what name soever we may call it, within the range of the solar action of the year, but which, in some way or other, modifies that action, how completely soever the modification may be unknown to us, or inscrutable by us. We must, however, confine ourselves to those points which are actually known, how few soever they may be, for the subject is one upon which we dare not take one step on conjectural grounds.

There are a few trifling particulars, upon which there does appear to be a faint glimmering of knowledge; and, as the dimmest twilight is better than absolute darkness, we shall hint at some of them. Rocks which absorb a certain *moderate* portion of humidity, appear to have a more kindly soil over them than rocks which have not this property; but this humidity must, of course, be retained in the substance of the rock, and not merely drained away by its vertical fissures, as it is in many of the mountain *schists*, which form a large angle with the horizon, or between its disintegrated particles, as is the case in a deep bed of sand. Upon such subsoils the seasons are generally more mild or uniform, than they are upon those of the opposite character. Subsoils which are very retentive, and will not let the water down, are in general favourable to green growth, but rather the reverse for flowering and fruiting; the flowers which naturally grow on them have not so much colour or odour as those which grow naturally on fine subsoils, and the fruits are more spongy, and of inferior flavour. The same holds in the case of bulbs and tubers. Sand, mixed with the soil, is in general highly favourable to flowering, and also to bulbs and tubers; but a mixture of clay, in a state of minute division and intimate mixture, is more conducive to general fertility. Of all rocks, those of the trap formation, which consist of flint, clay, and more or less of lime, with a few other ingredients in smaller proportions, appear to yield the best soils when decomposed; and their decomposition, by the action of the atmosphere, appears to be more easy and rapid than that of most others.

The list might be further extended; but it will be perceived that in these, (as it would be in others,) we are brought back to the point with which we started,—namely, that it is the water which these subsoils retain or discharge, which is the important part of their relative value. If the soil is retentive, much of the heat of the sun is carried away by the evaporation, until the surface is dry; and then, after this, the surface gets strongly heated and binds, so that both the heat and the air are prevented from getting into the earth, even to the moderate depth which is most favourable for Summer action; and while the mere crust is nearly as hard as a stone, the consistency only a little way down may be that of mortar. On breaking up some of the roads near London, where the clay has been in great part used in banking them up to the proper level, a quagmire has been observed at a small depth below the carriage-way, even in the driest time of the year.

To point out the specific influence that each, even of the few circumstances which we have enumerated, has in preparing the earth for the grand action of the year, would be no easy matter; and though done, it would be of very inferior value, as the list of what we know is probably very small in comparison with that of which we know nothing. All, therefore, that we can do, is to mention a sort of average, and that is necessarily rude and imperfect, and must be taken with reference to the humidity of the ground, more than to any thing else.

The rains or snows, as it happens, according to the latitude and climate, of the winter and the early part of the spring, completely saturate the soil with humidity. When the returning influence of the sun begins to act upon the earth, it is at first almost wholly occupied in evaporating this humidity, so that it has little effect in warming the soil itself, or in stimulating the vegetation. The moisture thus evaporated is condensed again and again, and descends in rain, hail, or snow, according to circumstances; but still it does wholly return in this way, and thus there is a progress in drying the ground, though at first it is a slow one. It is probable, however, that this very moistness of the surface, by interposing a barrier between the cold air over the earth and the substance below, even at the moderate depth where the roots of trees are, and the ground annual is, reposing for the winter, prevents the heat, which those parts had received in the latter part of Summer, and especially during a dry and warm autumn, from escaping so much as it would do if the surface of it were more dry, and consequently better fitted for the radiation of heat. It cannot be considered so perfect a barrier as a covering of snow on the surface of the ground; but it unquestionably is an approximation, and a very useful one as regards ground vegetation. In respect of the former, it enables the roots of plants to put out the young rootlets, which are the feeding apparatus of the plant, in so far as it draws its nourishment from, or through the medium of, the ground. In all plants which have seasonal action, and a period of repose, whether they last for two seasons only, or for any greater number, these rootlets are as annual as the leaves. In the case of a tree, which, from its longer duration, is the best example to which we can refer, these rootlets are the parts which are first developed and come into operation, in the action of the year. They are in fact essential to the full and healthy development of all the above-ground parts; and this is the reason why a transplanted tree so very seldom shows perfection in leaf, shoot, or flower, the first year after the transplanting.

The formation of the rootlets requires more humidity than the action above ground, and it needs comparatively little influence of the air, and almost none of light. The rootlet, as long as it performs its function as a feeding apparatus, is thus a blanched and feeble thing, very tender and spongy in its texture; and this is exactly the condition which fits it for its office, for the parts of it which absorb are so like little sponges, that they are technically called sponglets. The formation of these rootlets begin in many instances as early as the winter solstice, and sometimes earlier; but, as has been said, both the rain and the snow are favourable to their production. The under-ground part is thus prepared early in the season by the state of the earth then; and in this way the winter may be said to be providing for the Summer, only it provides in so secret a manner as not to be open to common observation, though it is of course well known and duly attended to by all who have the care of plants, and find an interest in studying their action and economy.

But the very same preparation of the earth for the action of the sun and the atmosphere upon it, which is thus favourable to the action of that part of the plant which is in the earth, in promoting the development of those organs which are necessary for the year, is equally favourable by restraining the development of those parts above the surface, for which neither the plant nor the season is prepared at this early period. Even if they were to meet with no casualty from the state of the atmosphere, if the buds were to come into action in the air before the rootlets are formed in the ground, they would be of the same imperfect and abortive character as we have stated takes place in a transplanted tree. But besides this, the alternations of the atmosphere in spring are much greater than at any other time of the year; and thus, if the bud were to expand too early, its produce, whether in leaf, in shoot, or in flower, would be destroyed. The evaporation and consequent cold which results, prevent this altogether in the very early stages, and check it until the drying of the surface is considerably advanced. The early spring flowers, of which a few will be found noticed in our volume on Spring, all have their support on roots, and not on stems, and, as we there instanced, some of the flowers come before the leaves.

When the drying has advanced considerably, and the evaporation in consequence abated, the moisture which still remains in the earth begins to act in a different manner. It meets the descent of the heating energy below the depth at which it is not lost by evaporation, at least compared with what was so lost in the earlier part of the season. There is still enough, however, for keeping the atmosphere rather moist than otherwise, especially during the night, when there is but little radiation of heat. This is the grand season of individual growth in all those plants which run their regular order of the root, the leaf, the shoots, and the flower during the course of one season; and as they are the only truly seasonal ones which may be said to begin and end their growth in the period of the year, they are the ones which are best suited for enabling us to understand the gradual succession of the seasons, and development of those appearances in nature which the seasons bring round.

Some may suppose, that as these are really spring actions both in what is done and in the time of doing it, they would have been treated of while mentioning the spring. That might, perhaps, have been systematic, or, at all events, more in accordance with the almanac, but it would have been very inferior in the way of a lesson of instruction, which is of far more importance. Nature draws no line of distinction between the spring and the Summer; for, if we take the progress upon the characteristic plant which begins with the beginning of the year, grows in all the period of its growth, and gradually subsides into repose in the period of its decline, the one course is unbroken from the growth of the first bourgeon of rootlets to the fertilizing of the rudimental seed; and the other is as unbroken from that to the final repose—which repose, if taken between the last action above ground and the first below, is far shorter than those who look only at the expanding and the falling of the leaf, would be apt to suppose.

As the action of the sun gets stronger and stronger, the ground feels it to a greater depth, and the heat of the sun penetrates farther down, until it at last so far overbalances the quantity of moisture, as that the action of the roots of most plants is suspended, and with that the increase in size in the individual. This does not, of course, take place at once, but gradually; earlier in some species and later in others. But wheresoever, and what manner soever, it takes place, it is the proper and ultimate preparation of the plant for the Summer action, namely, the expanding of its flowers, and the fertilizing of its seeds.

This general preparation of the earth for Summer, can be explained only with reference to the vegetable tribes, because the earth of itself really tells us nothing farther than that it has a certain degree of heat, and of moisture, or of dryness; and we must cull the effects of these as they are displayed in vegetables. The details even of this observation do not singly make much for the illustration of the general question; and they are so numerous, so varied, and many of them so apparently contradictory of each other, that, even if we had room for the whole enumeration, one entire volume would not suffice for the tenth—no, not for the hundredth—part of it; and it would afford little interest to the ordinary reader, or, indeed, to any reader. There are many plants in which the preparation of the ground, either for or by the Summer action, does not suspend the growth of the individual. The part which flowers, indeed, always has its final action in the ripening of the seed; but there are many plants which continue their green growth in other parts, except in situations of great heat and drought.

Plants of this kind are chiefly *stoloniferous*—that is, they put out shoots from their roots. These are most common, or, at all events, most conspicuous among the numerous and important family of the grasses, not merely those which occupy the earth in temperate climates, but in some of the giant gropes of the lands of the sun. The sheep's fescue grass, which is one of the greenest on the dry downs in Britain, has this property, and so has the bamboo, which is the most majestic of grasses, and, in soils which are very favourable for it, rises to the height of eighty or a hundred feet, and yet is still a grass, and the growth of a single year, though it takes another to consolidate. But in the extreme Summer preparation of the ground, most of these plants are so tenacious of life, when that life retreats to the root, that they become green again whenever they have sufficient moisture.

In noticing this preparation of the ground, and also that of the atmosphere, we have had occasion to make so frequent reference to vegetables and their preparation, that we shall not need to introduce them as a separate branch of nature's Summer economy. Thus, there remain only the water, and the animals, aquatic and terrestrial, which we shall make the subjects of other three chapters.

CHAPTER V.

PREPARATION OF THE WATERS, ESPECIALLY OF THE SEA, FOR SUMMER.

The waters, considered in themselves, as they form one of the great constituent parts of that surface which the earth exposes to the action of the sun, demand our consideration, in the fourth place.

The sea is a most sublime subject, in every view that can be taken of it; and the Summer of the sea is one of the most wonderful in the production of life. Not only this, but the fresh waters are, in themselves, a study beyond the powers and the duration of life in any human being. They are this in their vegetable productions, and yet more especially in their animal ones. Both kinds of life are, of course, most abundant in the waters of the tropical countries, whether in the sea or in the inland waters; but there is no part absolutely barren, not even the sand on the beach; and the production of many of the waters in high latitudes is great beyond what any one can imagine who is ignorant of the hosts of insects which annually take the wing from the marshy pools in the woods of Lapland or Canada.

It is not with the productions we have to do in the mean time, however, but with the preparations; and here all the comparisons which we are apt to institute between the workings of nature and of art, are set at such utter defiance as to convince us that we cannot make any thing which we plan and do, a model or guide in any one part of nature. In the sea, there is the least preparation, and the greatest uniformity all the year round; and yet in it there is the grandest production, and also the greatest productive power.

In the great body of the broad waters, observation is necessarily very imperfect; because, even in those oceans which are navigated the most frequently, only a few points are seen, and the view which is obtained, even of these few, is momentary and fleeting—fleeting never to return. The navigator may determine his position on the trackless main, with all the accuracy which the finest instruments, and the most skilful applications of science will admit;—that is to say, he may find his latitude within two or three miles of the truth, and his longitude within twenty or thirty. This, it would be admitted, is no very precise determination of the situation of a point; and yet even this cannot be obtained but by the most careful observers under the most favourable circumstances.

But granting that it could be done any day or every day, and done as nearly to an inch, or even to a hair-breadth, as it is really practicable to a mile, what is it after all? Does it determine the position of any one portion of the sea? No—not of a single drop. The very same water which is found at a particular spot upon one voyage, may, by the time that the same relative spot on the earth's surface is reached on another voyage—if it can be again reached (for it is no ordinary matter to steer for the same spot on the open sea) be at the antipodes, in the clouds, in the current of a river, in the substance of a plant, or in the body of an animal. Man might have some chance of again finding the same portion of the sea, if he could set his signet upon it, so as to leave a permanent impression; but, till he can do this, it is utterly hopeless and impossible. What is true of the water itself, must also be true of all those loose and floating productions which make the broad waters the home of their dwelling. They are numerous beyond all counting, and many of them are various beyond all description; but they will not come within the limits even of that very vague knowledge which we have of the production of the land.

In the eddies of the great oceans, there are floats of sea-weed rivalling in extent islands of large size, and they are peopled by countless myriads of living creatures, for many of which we have no names, and of far more we have no knowledge. In the currents there are living things innumerable, sufficient for the maintenance of many sea birds, and of countless aquatic animals, including even the huge bulk of the Greenland whale—without any perceptible lessening of their numbers, by all the food which they furnish to their larger neighbours of the same wonderful "dwelling;" for, while the habitations of life upon the land, whether we call them houses, or burrows, or dens, or nests, or perches, or hills, or any other places, named or unnamed, which land animals inhabit, they are all detached from each other, with intervals between; but the sea is "house all over," in its breadth, and in its depth as far below the surface as life of any kind can exist; without one vacant place or partition of an inch, or even a hair-breadth. The wake of a keel, or the splash of an oar, may disturb countless myriads of living creatures, which are quite undiscoverable during the day, and show themselves only by the blink of phosphoric (?) light which they give out when their dwelling-place is disturbed in the dark. Even a single pitcher of water, drawn from the most apparently limpid part of the ocean, may contain thousands—aye, millions—of living things; for, if such water is boiled, it gives out a smell, not merely of animal matter, but the peculiar smell of those invertebrated natives of the sea with which, from their larger size, we are better acquainted. The broad sea, therefore, must always form a theme for our wonder and our admiration; but it never can become a subject of accurate and intimate knowledge.

The shores of the sea, especially those portions of them that are alternately dry and covered, by the tidal ebbings and flowings of the water, in which the gravitating influence of the sun and moon works equally for our health, our commerce, and our instruction, are more open to our observation, and more seasonal in their character. These, therefore, come more nearly within the limits of what we may consider the science of nature. But even they are by far too much for us; and to our shame, as beings gifted with powers of observation and reflection, they are sadly neglected by us. We—that is, all of us who can afford to do it in what we call "proper style," which is, perhaps, the most improper expression in the whole of our very unphilosophic speech—resort annually to some part of the sea coast; but we do so at a very improper season, and without the preparation or desire necessary for understanding the sea; and, therefore, we return from it in nearly the same ignorance of its economy and productions as if we had spent the time in a counting-house, or a coal-pit. We go there after the Summer of the sea is over, and we walk a little, bathe a little, look, perchance, at a few fish on the beach, in order to cheapen them for dinner, pick up a shell or two, perhaps; and then close the day with the same feastings, amusements, and mental occupations, as if we were all the time in the heart of some inland city, and there were no such thing as a sea on the whole surface of the globe. This is not meant for censure upon any individual or class of society; for we are so much the creatures of original training, of the fashions of the times, and of several other circumstances which chain us down as if they were, which they are not, necessary laws of our being, that our very vices are hardly our own, and far less our follies.

If the sea is to be enjoyed in its own bright and broad expanse, or in those wonderful congregatings and workings of life which are to be found on its shores, the proper time to select for this purpose is the sultry noontide of the Summer, when the land is at the maximum of its dryness, and all upon the land is languishing under the extreme fervour of the sun. The drought has been of long continuance. The ponds are empty, the rills dry, and the ordinary river has shrunk to a mere rivulet, while, instead of that cool breeze which its unabated tide sent abroad, its wide banks of dry shingle and sand are as hot as ovens, and beginning to spot the meadows with brown, by consuming the sap of the vegetation. The parched common invades the woodland to the very leaves of the trees, and the leaves of those nearest to it are seared with the tint of autumn. There is no refreshment for the burning cheek and the throbbing temples, in the shade of a tree, for the thirsty air has parched every leaf to perfect flaccidity, the buds can barely maintain the life; so that the noble of the wood, which at other times both shades and waters, now parches up the ground on which it stands. The merry "moanings" (for they are merry) of the turtle, and the solemn joys of the cushat, are now no longer heard. Not a hum is over the drooping flowers, for the burning air has drained every nectary of its honey. When evening comes on, the sun sinks like a globe of fire, without a cloud to curtain his descent, and receive the last limnings of the day. The orb has withdrawn, but the burning sensation abates not a jot; the scorched earth reeks in radiation, viewlessly, indeed, though it were day, for every particle of water, even though drawn from fathoms in depth, is dispersed in atoms which no eye or instrument can find; one cannot sleep, but there is no joy in the voice of the night—no note of that sweetest of songsters, which is so dear to the sleepless—instead, the querulous treble of a gnat jars on the ear, and puts one in mind that there is venom in the time. Morning breaks, but it is no "meek-eyed morn, mother of dews." It appears to burn under the horizon, as if clad in the flames of a thousand volcanoes; and when the first pencil of the solar beam finds out the mountain top, it cleaves through the air, like the lightning of the desert, and not a dew-drop forms to refresh a single flower in the valley. You come abroad; but there is no

"Breezy call of incense-breathing morn."

The earth rings like bronze under your feet, and the sky is as a dome of hardened steel. Where is the sky-lark, which, erewhile, rained melody upon the fresh and fragrant fields? Silent and motionless among the clods. A solitary rook, uttering one melancholy "caw" as it passes, speeds away to seek the upland springs, as the low fields are all proof against the efforts of his bill. It is hotter even than yesterday; and, before the sun has gained his meridian height, the whole of nature around you is as still and silent as if the destroying angel had just passed over it. O, for a sea-breeze, to fan the earth into life! They *have* such, even under the perpendicular beaming and burning of the sun; and they are delightful.

Then, onward to the sea. The earth is in all the quietude of death, but the water is "the living water" still. Its tide will refresh your weary limbs, and its gentle breeze will revive your drooping spirits. It is calm and inviting; but there is a gentle ripple, showing a play of the most delightfully transparent colours, and there is a subdued gurgling among the pebbles, and just a thread of silvery foam marking where the refreshed land and the refreshing waters meet. That ripple, and that thread of foam tell you that, whether ebbing or flowing, those waters are constantly sending refreshment to the adjoining fields. It is true that the benefit, in its direct influence, extends only to the first hill of any elevation; but it is thereby concentrated: while, if spread over the breadth of the country, it would not be felt any where. The breeze freshens with the set of the flood; and there the air on the downs is delightfully bracing.

Yes, when, in the season of drought, the land is parched to the total suspension of all vegetable action, and every animal upon it is faint and languishing, the sea is in the full vigour of growth and life. Even in those parts of the world where the land is perennially, and utterly barren, or in such a state as to be quite unavailable for cultivation, and altogether and hopelessly impracticable as the habitation of civilized man, the sterility of the land in no wise invades or affects the sea. Take any locality that you please—the Atlantic on the coast of Sahara, or the Indian Ocean on those of the barren parts of Australia,—and the sea is as fertile as if the land which it washes were the garden of the globe. The north-west portion of Australia is of so barren and irreclaimable a character, that no art of man could make ten thousand acres of it supply food for a single sheep. But not so the adjoining waters, for they are redolent of growth and life. The bottom, where it can be seen,—and it is seen to a far greater depth than in our seas, because the almost perpendicular beams of the sun are not so reflected and refracted, but penetrate far into the depths, and produce the action of a vigorous Summer there,—the bottom, in the number and luxuriance of its productions, and the variety and richness of their colours, emulates a garden of the richest plantation, and the highest culture. No doubt, the seeming fruits and flowers of this submarine splendour of nature, which have been described by the gallant, but unfortunate Flinders, and others, as melons, cucumbers, anemonies, and so forth, are animals, and not vegetables; but that heightens the interest of the scene, instead of detracting from it. Then, the other productions of the sea are equally abundant. Fish literally crowd the waters; the turtle come to the shores in such abundance, at that season when the grand purpose of nature requires them to be there, that a squadron may be supplied with fresh provisions of the choicest quality, in the course of a single evening, without money and without price, and at a comparatively small exertion of labour. That, too, is one of the favourite haunts of the great spermaceti whale; and the lamps in our chambers are lit up by the product of the sea on these barren and irreclaimable coasts.

It is one of the great advantages of the sea, when we look upon its waters, in such a situation that the opposite shore is not seen, that it insensibly but pleasingly leads our contemplations round the globe, and places all lands, with all their productions and inhabitants, in fresh and forcible portraiture before our view.

And while, in this kind of survey, we contemplate the sea and the land in their contrast, it is impossible not to notice the Red Sea, as being one of the most extraordinary spots on the face of the earth, and one in which the contrast of sea and land is shown in the most striking manner. The lands, upon all the shores of the Red Sea, are of an arid description; and there flows into no part of it a stream of water that can be called a river, even in the seasons of the rains. The land, on the African side especially, is worn to the very bones, and even the rocks, which may be considered as the bones of the land, are in a state of decomposition and decay,—the very mountains are buried in their own ruins, much in the same way that ancient cities are in many parts of the world,—only there comes a mantle of vegetation over the ordinary ruin, but here there is none. The solid mountain, long since despoiled of its vegetation, and its vegetable mould, is now broken like a potsherd, and where the fragments are still too heavy for being blown about by the winds, they drink up every drop of the rain, and are both plantless and tenantless.

But when we turn from these wasted and worn lands, to the sea which washes their coasts, we find not one symptom of desolation or decay. Vegetation in it is like a forest; and, perhaps, there is no portion of the earth's surface, of the same extent, that supports so many, and so varied animals. There are some other circumstances connected with the Red Sea, which draw our attention to more extended uses of the world of waters, than any which come within the scope of a season, a year, an age, or a period of time as long as that to which human history reaches back.

In some parts of that sea, countless thousands of *polypi* are constantly at work, in forming coral reefs, which render the navigation peculiarly dangerous, as a ship may, on a second voyage, be wrecked upon one of those reefs, at the very spot where, on a former voyage, a few years previous, or only the preceding year, there was an ample depth of water, and not the least vestige of that reef, which now extends for miles, and rises nearly to the surface. Then, in other parts of the same limited sea, volcanic fires are constantly in action, and additional islands and dangers to the navigator are in the course of formation by their means. Along with this, there is an activity of vegetable and of animal life, which is truly wonderful; and there are, probably, more living creatures in the Red Sea than upon any ten times the same extent of land on the surface of the globe.

The Mediterranean may be cited as another instance of this extraordinary productiveness of the waters; and its productions are of a much more tropical character than those of the lands which abut on its shores. The countless numbers of the larger spinaceo-finned fishes, sporting near the surface, which make the Mediterranean gay with the tint of every colour, the lustre of every metal, and the glow of every gem,—the groves of precious coral,—the multitudes of crustacea, mollusca, and all the other productions of the deep,—all tend to make this inland sea one of the wonders of nature; and there is really nothing in the same latitudes of the Atlantic or the Pacific that can vie with it. The fact is, that the Mediterranean, in many parts of its bed, resembles "a seething pot;" and, as is the case in the Red Sea, there is no doubt that these nether fires contribute to the life and growth with which it so much abounds.

These are, however, to be looked upon as merely local properties of those particular seas, not belonging to, or, at least, not displayed at all times by the sea generally, and not affected by the Summer action, or by any seasonal change that does, or can, take place in the revolution of the year. Still they are important, when we come to take a long historical view of our planet; a view which it is not only desirable for us to take, but which we cannot help taking, if our trains of thought are, even in a very slight degree, philosophical; and we shall probably have to revert to it for a little, after we have considered the seasonal character of the sea, simply as an accumulation of water, connected together, and as such, preserving the gravitation and rotation level, unless as so far affected by tides and currents.

In doing this, the first subject which presents itself for our consideration is, the way in which the water, considered in itself, is affected by the increased temperature which precedes and produces the Summer. Now we know that water freely exposed to the atmosphere, at even one of its surfaces, never can be made hotter than the boiling point, or 212° of the common thermometer. Above this heat, it naturally passes into steam; and though, under the confinement of strong vessels, the steam so produced may be raised to a very high temperature, yet the part of the water which remains liquid is never hotter than 212°. There is a practical illustration of this in the boilers of what are called "high pressure" steam engines, that is, engines in which the steam is forced to a high temperature. In this state, its elastic force increases greatly, and it might be rendered so great, that, if completely confined, it would be sufficient to burst asunder any vessel, or even the globe itself, how small soever the steam were in quantity; and we do frequently hear of dreadful accidents from the bursting of the vessels of those engines, by the elastic force of the steam,—which, indeed, would happen in all cases, if safety-valves were not provided for limiting the maximum pressure, or elastic force of the steam.

The action of the solar heat upon the water of the ocean, or, indeed, upon any portion of water whatever, never produces anything like this temperature; but still, in so far as the mere heat is concerned, the operations are exactly the same in principle.

But heat, though one great cause of evaporation, is not the only one, for when air and water are exposed to each other, the water has always a tendency to distribute itself through the air, in a state of vapour, whatever may be the temperature of the one or the other, or of both. This is modified by the temperature, no doubt, and it modifies the temperature in return; but we must take both principles along with us if we are to look with understanding upon the seasonal action of the sea, even in the simplest view we can have of it, which is obviously that of a mass of water, without any regard to the plants and animals which that water excites and sustains.

We may thus regard evaporation as a process which is constantly going on, wherever there is water to be evaporated, and whether that water is liquid, or in a state of ice. This formation of vapour invariably renders insensible, or, as we say, "absorbs or consumes" a certain degree of the action of heat. Thus the surface at which the evaporating air and evaporated water meet, is always in a state of cooling, in proportion to the degree of evaporation. We shall not state any of the proportions, or ratios, numerically; because we have not to do with the chemical details, but with the general principles, as they are necessary to guide us in the proper observation of nature.

Here there arises a question which is of considerable importance,—namely, whence the heat is derived which maintains the water in a state of vapour, if there is nothing present but the air and the water, and their temperature is exactly the same? Is it more from the air or the water, or is it equally from both? This, though an exceedingly simple and elementary question, is yet one of great importance to a proper understanding of the seasonal action of nature, and especially of the different actions on the land and the sea, and the reciprocal action of these upon each other, which last are carried on through the medium of the atmosphere, and through that only, in so far as seasonal results are concerned. Hence, the action of water surface, and air surface, upon each other, is the grand foundation of a right knowledge of the seasonal economy of the sea; and when we consider that the sea covers seven-tenths of the entire surface of the globe, and is considerably more than twice the surface of the land, we may confidently say that this is the most extensive physical action upon the earth's surface, and by being the most extensive, it is the most useful,—for the benediction upon the whole system, by its Creator was, "it is" very good; and, consequently, the greater that it is, the greater is the good.

But to return to our question,—the single consideration that steam, or vapour, can be heated above the boiling point, and water itself cannot, is sufficient to show that the greater supply of heat, for the purpose of evaporation, would, under the supposition of there being nothing present but air and water of the same temperature, be derived from the water. This being the case, it follows, by necessary consequence, that, when we take into consideration a third element, namely, the solar action, as heat, then this action must tell less upon the water of the sea than it does upon the atmosphere over that water, and this altogether independently of the transfer of the water from place to place, from whatever causes these may arise.

But we have to consider the solar action upon the sea, both as heat and as light; for though these do not follow exactly the same law, or produce any thing like the same results, they always act simultaneously, and increase and decrease together.

Where the rays of the sun come perpendicularly, both heat and light penetrate to the greatest depth, and in the greatest fraction of their whole quantity; because, when they fall in this state, there is no refraction at the surface of the water, and the refraction from that surface is the least possible. If the surface were perfectly smooth, if the depth of water were not very great, and if the light and heat were constantly to fall perpendicularly on the same part of the sea, the consequence would, in all probability, be to convert the sea into steam, which would be nothing but the drying of the ground by sunshine. This, however, is a state of things respecting which there is no necessity for speculating, beyond the simple statement of it, because it is a state of things which does not, and cannot happen, under the circumstances in which our globe is placed. The surface of the most glassy sea is always more or less dimpled, therefore there is always some refraction and reflection at the surface. The sun-beams are only momentary in their perpendicular fall on any point of the earth's surface; and the same portion of water which receives the perpendicular rays of one solar noon, probably never receives those of another. We see, therefore, that the ocean has a power of conservation in itself, against any destructive action of the sun, at those places where that action is at a maximum; and, therefore, we may lay it down as an axiomatic truth in the science of nature, that the sea can never be wasted and worn by the action of the sun, as the land is found to be, in many places totally and irreclaimably, and in others seasonally, and demanding the protecting and profitable labour of man, as explained in a former chapter.

There are many other considerations connected with the sea, bearing upon and illustrating this remarkable property of the indestructibility of the waters, and their security against decay or wear, in the common revolutions of the seasons. In the first place, there is a constant tendency of the ocean waters to the place of greatest evaporation, in exact proportion to the quantity evaporated, and immediately as it is evaporated, in the balance of gravitation and revolution, which balance instantly restores its own equilibrium. Thus, if we are to suppose that any one part of the tropical ocean is heated to an extreme degree, by the action of the sun, the whole ocean, to the poles, sympathizes, so that, let the ardour of the sun be what it may, it cannot lower the surface of the water a single hair's-breadth, as a permanent level. Therefore, if we were to return to the supposition of a destructive action of the sun upon the waters, any very serious result of that action would be an exceedingly protracted one, for, so to speak, the water of the sea would contend by inches, by infinitesimal divisions, so that there is no saying how many years or ages might be required to raise the temperature of the whole ocean a single degree, even though there were no abstraction of heat from it by the process of evaporation.

Secondly, as acted upon merely by the solar influence, it is probable that the atmosphere, taken as a whole, contains, at all times, very nearly the same quantity of water in a state of vapour; and it is agreeable with the general law of nature to suppose that this is exactly the quantity which the volume and character of the atmosphere make it capable of receiving. There are great variations in different places, and at different seasons, and we have no very exact means of ascertaining how much water is in the atmosphere, as our hydrometers do not measure the absolute quantity of atmospheric moisture, but only the degree of disposition which the atmosphere has to part with that moisture; but notwithstanding, we have no reason to doubt that the average quantity remains always very nearly the same.

But though those properties of water and of air, and of their reciprocal actions upon each other, which have been mentioned, give to the sea a self-preserving power which the land does not possess, and also enable the sea to minister greatly to every thing that grows and lives upon the land, yet it by no means follows that the sea is without Summer action; or that, though it is as constant and perennial in the growth and life that it supports as it is proof against natural distinction in its own volume, it does not necessarily follow that the sea is without its periods of revival and decline in its productions, any more than the land.

Indeed, the circumstances of refraction and reflection, which we have mentioned, as rendering the sea a benefactor to the atmosphere in the matter of heat, tend to give far more difference of seasons in the sea, than the power of circulation in its waters would admit, if their equalizing effect were not in so far counteracted by these causes. We have mentioned already, that where the solar beams fall perpendicularly, they penetrate the water with the maximum of effect, both as to intensity and to depth; and it will be readily understood, that when those rays pass horizontally over the surface, their influence upon the water must be little or nothing. From what we have stated, it will also readily be understood that heat communicated to the water of the ocean, where that water is very deep, must be, in a great measure, dispersed by the mobility of the water; whereas, in the shallows, the heat will reach the bottom, which is not mobile, but must remain and abide the effect of the heat, and also communicate a portion of that which it receives to the heating of the water over it.

In their general transfer from place to place, the waters upon those shallows have much less motion than the surface waters of the depths of the ocean. Of the bottom waters of the great deeps we know little or nothing; we have no reason to suppose that they have much transfer from place to place. They, like the depths of the earth, are beyond the sphere of surface action, and also of life and growth; and therefore, in them, and to them, all seasons of the year must be nearly the same. Consequently, we are not called upon even to speculate concerning them. If we could see them, they would, no doubt, be wonderful places—sad charnel-houses of bones, and shells, and various other remains. But they do not belong to the world of our observation as connected with the present time; their connexion with the past, though there are proofs of the deposits of ocean depths miles high upon the mountains, are but dim and shadowy, and our considerations of them are purely conjectural. Both ways, indeed, they beckon us onward to states of our planet, in which it could not be, and cannot be, the habitation of human beings, like those which belong to the period of our history, in the whole of its succession.

The shallows are more within the scope of our observation; and they are both interesting and useful. All the tidal portion of the shores, between the lines of high and low water, is placed under the most favourable circumstances for growth and life. There are many reasons why this should be the case; but it is necessary to mention only three of them. First, those portions of the shores are the lowest-lying solid surfaces that are ever exposed to the action of the atmosphere; and the atmosphere is, in consequence, warmer and more dense over them than over any others, by which both the force and the resistance are increased, and both tend to increase the action. Secondly, those surfaces are, twice every day, exposed to the sun, or, at all events, to the atmosphere; and twice every day they are watered by the return of the flood-tide. It is true that the water of the sea, being impregnated with saline matters, is fit only for a particular kind of vegetation, and not so well adapted for that as the bottom within the line of low-water: but it is particularly well adapted for the smaller kinds of aquatic life; and when the water, which has been heated on the beach, ebbs to seaward, which it does on the surface, being specifically lighter than the colder water, its influence extends a considerable way, so that, after the season has made some progress, the water over the whole of the shallows becomes heated, and gives a stimulating effect a good way to seaward. Thirdly, though at many points the sea is constantly at work, cutting down the land at one place, and throwing up banks at another; yet there is, upon the whole, an accumulation of matter at the average of the line where the sea and land meet. The *débris* of what the sea and the rivers flowing into the sea, disintegrate, is sometimes carried to considerable distances, and occasionally so far, as to "bank the mid-sea"—as is the case between Britain and the continent of Europe. But though this happens in some cases, these may be regarded as exceptions; and the rule is, that the sea casts back to the land what is washed into it by the rivers and rains, or blown into it by the winds. There is another consideration: we might infer from analogy, and the analogy is confirmed by observation, that the sea wears down high lands, and forms low ones. We can easily understand why this must be the case; where the land is low, and the bottom of the water shelves gradually outward, and the water itself is shallow to a considerable distance in the offing, there is no power, either of wave or of wind, to make any very great impression on the land, unless some peculiarity of the place shall turn the "set" of a strong current directly upon it. The sea wind, which is the one that has most effect in the wearing away of the land, passes inland, over the low surface, without any interruption in its passage from sea to land; and where there is no interruption to action, that action, however powerful, shows no effect. Then, in the shallow water, on a shelving beach, there is no room for the formation and play of a wave of such magnitude as to be capable of any very powerful effect. Waves, it must be understood, are not, even in the case of a flowing tide, where it has ebbed back for miles, masses of water advancing at that rate at which they appear to advance, or moving in any direction, at any rate whatever, unless they are carried along by some other movement of the water on which they appear. They are mere vibrations of a portion of the water near the surface; and, in themselves, they move neither one way nor another; they merely swing upon their centres of gravity—the ridge and the trough alternating with each other, and the time of their alternation following the same law as that of the vibration of pendulums, namely, that of the square roots of the lengths.

Thus, upon the shallows, the vibrating wave strikes the bottom, and as sure as it strikes the bottom, it breaks at the top, and the power of the vibration is exhausted in a sort of internal conflict in the waters, so that they have little or no effect upon the land; and though, upon a shelving beach, one may see a wave apparently advancing with such force and fury, as that it would dash the beach to atoms, yet it falls headlong before it reaches the land, and demonstrates, that though formidable to any thing that may lie upon the sea, it is quite innocuous, in so far as the land is concerned. On the shallow beaches, therefore, the stroke of the wave is on the bottom, not on the shore of the land; and this is the chief reason why beaches, upon which the sea ebbs back to a great distance, are generally among the most barren which the sea any where presents. The strokes of the waves keep the pebbles in a state of constant agitation and movement from one place to another, so that sea-weed cannot have rest to grow, and there are, comparatively, few animals, though there is still too much, and too valuable action of nature in such places, for their being wholly without inhabitants; and what does not tell upon the waters tells upon the land, so that, unless the unproductive sandy downs, left by the retiring sea, are of all the greater breadth, the land which has a shelving shore is generally of a very fertile character in proportion to the kind of soil of which it is composed.

Upon bold and rocky shores, where the deep water comes to the base of the precipice or the lofty cliffs, the state of things is very different, both as regards the action of the wind and of the waves. The sea-wind, coming with violence against the lofty steep, is there interrupted, and a condensation takes place, by means of which the wind beats with a degree of severity quite unknown to it in places where there is nothing to arrest its current. The condensation causes rain against a high and beetling shore, where it would not occur if there were nothing to oppose the atmospheric motion; and thus there generally are, in the crevices, and on the little ledges of bluff shores, overhanging the sea, vegetables which are unknown on the low parts of the coast. The waves also have their full sweep and swing, not only in the single wave, which is broken and has no room in the shallow parts, but in the aggregate of the agitation of the sea, in which wave rides upon wave, till the masses of the compounds are mountain high, and the troughs between them valley low. In consequence of this, they acquire a mechanical power which single waves never can possess, and by means of this power they thunder against the precipice with a force which no one would readily believe that water could acquire, and the effects of which must be seen before the force itself can be fully understood. The agitation of the water, at such places, is sufficient to move large masses of stone, which are hurled against the breast of the cliff with a violence which it is hardly possible to describe. If the cliff is composed of matters having a uniform consistency, and inclining to softness, it is gradually worn away, tumbles into the sea in fragments, and is transported to the banks in the eddies of the tides and currents, or upon the low shores, as we find to be the case on the southern parts of the east coast of England; and if the earth is composed of more sturdy and resisting matters, all the softer parts of it are scooped into caves, which often penetrate to a very great distance below the land, and are, not unfrequently, perforated up to the day at their terminations, presenting the most sublime of all appearances that are to be met with where sea and land meet.

In those places, however, there is a wonderful production and maintenance of growth and life upon all those rocks over which the action of the sea has passed without effecting their ruin, and thus become the means of their preservation. They become covered with various descriptions of sea-weed, which gives shelter to a vast number of small animals, and of the larger crustacea; and these again afford food to numerous and peculiar races of fish: so that these wild parts of the coast have an interest about them that does not belong to places where the meeting of the sea and land is of a more mild and subdued character. But, even in such places, there is a seasonal action of the margin of the sea, increasing in its variation from season to season, very nearly in the same ratio as the seasons vary upon the land, and decreasing in depth as the place is more distant from the equator.

The absolute depth to which the influence of the Summer extends in the sea, is not, however, a matter that can be numerically stated for any particular latitude, any more than the fertility of the land can be so stated. But there is a general law in the one case as well as in the other; and this law must be our guide in our general inquiries and speculations upon the subject. At the equator, or at the parallel of maximum solar action, which is a few degrees to the northward of the equator, the Summer influence penetrates to the greatest depth into the sea. Probably this is nearer the equator than the parallel of the sun's greatest action upon the land, as the surface of the sea is more uniform in its character; but we are not called upon to state this numerically; and though the call were made, we are not in possession of all the elements required for giving a precise answer to it.

At the parallel of the sun's greatest influence on the sea, there is of course a maximum of depth to which all the growing and living things there are stimulated. It may be less and it may be more, and it is not the same in all longitudes; but let us take it at the depth of one hundred fathoms, or six hundred feet. This gradually lessens as the latitude increases, until, as we may naturally suppose, it "crops out," or comes to the surface, at, or nearly at, the latitude where the line of perpetual frost touches the mean level of the sea. We have thus a curious shell of the ocean waters, of considerable depth in the middle or equatorial latitudes, and diminishing toward the poles, in which the solar action is excited, and which changes upon the same general principle, though not at the same rate in the details, as the solar action upon the atmosphere and the land. This, of course, shifts with the shifting of the seasons, northward when it is Summer in the northern hemisphere, and southward when it is Summer in the southern; but it tells differently in different places, according to the depth of the sea, and the character of the bottom, just as the seasonal action tells differently upon the land, according to the elevation above the mean level of the sea, and the character of the land itself.

Perhaps the maximum of solar action upon the sea may be taken in Torres's strait, and all the way along the north coast of New Holland, as the water there is not very deep, and the bottom is peculiar. Those navigators that have been sent to that particular locality, for the purpose of making observations, all agree in representing the heat from the sea at mid-day as being almost intolerable. The bottom consists of white sand and broken shells; and when the sun beats perpendicularly upon it, the heat which is sent up is like that of an oven. It fosters many kinds of life, but it appears to be too intense for other kinds; and thus, like the most burning parts of the land, it is not so productive as those which have their temperature a little more mild. There is one circumstance worthy of notice, which tends to augment the heat of this singular portion of the sea, and that is the lingering of the tidal wave over it, of which more notice will be found in our volume on "THE SEA;" but this extreme heating of the water appears to be favourable to some kinds of living creatures, more especially to the small animals that construct the coral reefs; for they abound there in such numbers and activity that their labours render the navigation exceedingly uncertain and dangerous.

The maximum of solar action upon the sea, which we have taken as extending to the depth of one hundred fathoms, though we believe that is considerably less than the reality, which is greater or less according to circumstances, and cannot, in fact, be accurately estimated, gradually becomes less and less, as the poles are approached, and ultimately crops out, or comes to the surface, leaving the whole of the sea under it, whatever its depth may be, an unproductive waste, in so far as local growth and life are concerned, although there can be no doubt that even this portion of the waters answers some important purpose in the economy of our planet.

But it will at once be seen that, even with the under estimate that we have made, considering the vast extent of the sea, there is room for action in it far exceeding any thing that the land can offer. According to the estimate of a maximum depth of one hundred fathoms, which we have made, (and we believe that we have taken it much under what it is in reality,) the productive volume of the waters is immense—equal to an average of about, say sixty fathoms over seven-tenths of the entire surface, and with a power of self-conservation, which none of the casualties to which the land is subject, in the ordinary course of nature, can possibly affect. This, too, it must be borne in mind, is a solid of fruitfulness, which the land is only a surface. It is true that most vegetables are rooted in the soil; though what they derive from the soil itself, and whether any thing but heat and moisture, of which the soil is the mere passive vehicle, is a point which is by no means determined, nor does it seem likely to become so.

But in order to avoid even the possibility of doing injustice to the land in the comparison, which, if not fairly made, would be worse than useless, let us say that the whole of the dry surface of the globe is available for the purposes of growth and life to an average depth of one foot. That is beyond the average depth to which the roots of vegetables penetrate; but let us take it as the basis of our comparison. This, at a uniform depth, will make three solid feet the term of comparison for the land. The habitable depth of the sea we have averaged at sixty fathoms; for, it will be borne in mind, that the greatest depth is all round the circumference of a great circle, and the least depth, or cropping out, is at a point, namely, the pole each way. Now sixty fathoms are three hundred and sixty feet, and seven times this is two thousand five hundred and twenty, which, divided by three, the term for the land, makes the productive volume of the sea eight hundred and forty times that of the land.

The result of this comparison is still greatly within the truth; but the elements of an exact comparison are not obtainable; and what we have stated is enough to show the great superiority of the sea in respect of capacity.

The length of all the shores, and the extent over which the tide plays, or beyond that to seaward where the action of the sun stimulates the surface and heats the water, to the maximum ardour of the season upon such places, cannot be stated in numbers. But any one who examines the map of the world, will see to what vast extent the absolute length of all shores are increased by the flexures; and that, notwithstanding the breadth of some lands, when we come to make allowance for the deserts, the barren mountains, and the other portions of the surface, upon which the Summer comes in vain, we shall find that in respect of quantity within the direct reach of the Summer influence, the sea does not fall very far short of the land. Besides, the Summer action upon the land has always, in the way that has been explained, a surplus working or tending to work for destruction, not merely in operating the final reduction to barrenness, but in destroying a portion of what is produced, in the very time of its production.

The boundary where the sea and the land meet is, on the average of the year, that which has the maximum both of powers and of stimuli, in all matters of life and growth; and though its vegetation is by no means so striking as that of the land, yet when we consider it in all its plants and all its animals, and join the constant activity of very many of them in all situations where the beaches are not absolutely frozen during the inclement season, we cannot refrain from acknowledging, that these places are really the gardens and the menageries of wild nature. These places not only support their own animals; that is, those which summer and winter, and live habitually upon them, but they are, at certain seasons of the year, the grand magazines, or stores, always abundant and self-supplying, to which numerous races resort at those times when either the broad waters of the sea, or the varied surfaces of certain portions of the land, are no longer able to maintain them, or do not answer the purposes of their economy. But this congregating of the creatures which live dispersedly at other times, toward the shores of the sea, is a matter of so much importance toward a right understanding of the seasonal economy of nature, and, above all others, the economy of the Summer, that we must make it the subject of a separate chapter.

It is not, however, in its value to the irrational creatures alone, that we find evidence of this paramount importance of the margins of the waters, for we have it in the history of the human race. In the least advanced races which have come to our knowledge in modern times, the chief habitation has always been the shore or the bank; and the grand store for food has been the sea or the river. The land, in a state of nature, yields but little upon which human beings can subsist; a few roots are all that can be obtained from it, without the laborious occupation of the hunter, and these only at particular spots. Wild fruits are seldom edible at all; and when they are so, the quantity of nourishment which they afford is so scanty, that, as is the case with horses on a bare common, people might eat themselves hungry upon them. We find that all the animals which live habitually upon such substances, are endowed with organs and powers of action, far superior to those of human beings, even when the latter are in the lowest state of mental development, and thus thrown the most upon their animal powers. Such animals have wings for flight, and generally powerful and rapid ones, if they are to depend wholly upon these. This is the case with all our native birds which feed upon seeds or berries, which they themselves gather from the plant; and it is still more remarkably the case with the passenger pigeons, and other larger fruit-eating birds, which have no power of climbing in addition to that of flight.

These birds of powerful wing are the consumers of the seeds of wild plants in places which are of a highly seasonal character, and they come and go in their seasons, by countless thousands—by untold millions; so that the ear is stunned by the thunder of their wings, and the thick-serried forest crashes under their weight when they roost for the night. Any one who chooses to turn to the account of the "passenger pigeons," in Wilson's "American Ornithology," will find, as true to nature as was that highly gifted man himself, a glowing picture of the birds which the Creator has appointed to gather the wild fruits of the mighty valley of the

Mississippi, until man shall clear the ground, and cover it with the fruits of his industry, and till the red Indian shall learn to scramble to the topmost bough in quest of the topmost berry. Such are nature's gleaners in the seasonal wilds.

If the Summer is perennial, and fruit always on the tree, as in the richer places of the tropical climates, both of the east and the west, the migratory wing is not necessary. Accordingly, we have the numerous and abundant races of apes and monkeys, all of them with four hands, or climbing paws, and many with the tail prehensile, so as to act as a fifth one. On the ground these creatures are awkward and ungainly, for the ground is not their appointed place; but their agility in the trees, and their command of even the remotest branch, would be truly wonderful, if we did not know Who made the forest for the ape, and the ape for the forest.

But, even in such places, there is a portion of the bounty of nature on the twigs, which the handed animal cannot reach. That animal, admirably as it is adapted for climbing, must have some strength in the bough to sustain its weight, and one bough to grasp if another gives way with it. Thus, the wing and the climbing instruments are combined, in the very abundant family of the parrots. They can scramble to the extremities of the sprays; for, taking the bill and the feet together, their organs of climbing are but little inferior to those of the monkeys; and, when their hold by these prehensile organs fails, their wings are always in readiness to bear them up, and carry them to their former position, or to a new one, according as it may be necessary. Thus, they are enabled to consume that portion of the surplus produce of the forest, which the handed mammalia cannot reach; and, as the productive power of every species of plant and of animal is always much greater than is necessary for keeping up its own succession, there is abundance for them, and no part of the bounty of nature is wasted.

Their adaptations to the different characters of the forests, which those forests necessarily put on in obedience to the law of nature, so as to be all equally fitted for the different soils upon which they grow, are not less demonstrative of wisdom of design, and perfect knowledge of the end, before the beginning. In places of constant growth, and extreme productiveness, where the supply of humidity is so great as that the influence of an almost continually vertical sun can work to its full extent all the year round, we find the parrots, properly so called, strong and compact in their bodies, and with a plumage which no scrambling among the leaves and twigs can injure; and, if the forest is in detached clumps, and verging outward to the dry surfaces, where the ardour of the sun tells on the bare earth, we have them with their feathers of flight drawn out to a greater length, and streaming through the air like meteors, as they pass from one clump to another. In short, we might follow the series downwards, till we met with them finding their food chiefly on the ground, and resembling, in some of their habits, the common pigeons, and some races of the poultry.

Thus we find that the wild animals are adapted to the wild forest, and to every diversity of it, in a manner which commands our admiration; and, if we were to follow out our survey from the gardens of nature—the oriental isles, and the richer valleys of Western Africa, and tropical America—to the extreme point of barrenness and desolation, to the desert, sowed with salt, and reeking like Tophet with the fumes of sulphur, or to the extreme of cold, where seed never germinated and breath was never drawn, we should find the adaptation every where equally perfect.

But, amid all this perfection—this diversity of perfection, great to the very bourne of infinitude—where shall we, mustering all the geographical knowledge—all the knowledge of places, productions, and laws of production and economy,—where shall we lay our finger on the map, and say, Here is the dwelling-place of man?—Here he can be comfortable and joyous, in the exercise of his animal powers, like the rest, and totally independent of the resources of that principle of wisdom and understanding—that immortal spirit—the only being upon earth capable of making progress in knowledge, and improving in conduct and enjoyment, wherewith the Almighty has been graciously pleased to bless him; and which, in truth, and not the mere body, is *the man?*

The land, from the lowest valley to the highest mountain top, says, "I possess it not;" and the wide sea thunders, with all its waves, "It is not in me." But man must, notwithstanding this, dwell upon the planet for his appointed time, and he must have both footing and food as an animal, before he can know, and plan, and execute, as a rational and reflective being; and this it is which fixes his locality, in the dawn and twilight of his understanding, to the line where the land and the water meet. Here, as has been said, he has invariably been found, where discovered in modern times, as in a state of extremest ignorance; and as time, though it greatly increases the volume of acquired knowledge, when men use it aright, in no wise alters the nature of an infant at its birth, we may conclude, that in every age and country, where mankind have been in the extreme of ignorance, their habitation has been on the banks of the rivers and the shores of the sea.

Nor is it difficult to perceive why this must have been the case, more especially on the sea shore. When the tidal action calls the water to seaward, it withdraws the veil from a table ready spread, and a table furnished with no stinted hand. Shelled mollusca, crustacea, and other small animals, live and multiply upon those wild beaches, in numbers and at a rate beyond the powers of arithmetic. Scarcely one of them possesses any deleterious quality, many of them are dainties even to civilized men, when eaten in the raw state, and they are all nutritious, and most of them racy. In former times, when the different parts of our own island did not communicate and sympathize with each other, as they do now, the failure of the crop was often dreadful in the poorer and remoter parts; and there have been instances, unfortunately too many, in which, while the people along the shores, though not faring sumptuously, certainly were preserving the life in themselves and their children, by gathering shelled mollusca, the inhabitants of the inland parts were found dead or expiring in the fields, with little pieces of early-springing dandelion, or sorrel, between their famished and bloodless lips. These dire calamities most frequently happened early in the season, when the atmosphere and the sea were so turbulent, as that the ordinary operations of fishing could not be carried on. But those celestial bodies, whose action produces the ebb and flow of the tide, are unaffected by the local violence of our atmosphere; and therefore, let the waves foam and chafe as they may, the moon will roll them back, with the same ease and certainty as though they were tranquil; and the table of nature will be furnished on the tidal beach, nathless the utmost fury of the storm.

Now, if these things have happened, or can happen, in a civilized country,—and they have happened within the lapse of the last hundred years,—how much more important must the tidal beach be to the poor savage, who has no crop upon the land from generation to generation! But we have enumerated only a few of those products of the tidal surface, of which man can avail himself, even though he is in the rudest state possible. Many of the sea-weeds are esculent, some of them are particularly agreeable to the palate, and all that can be eaten are healthy; besides, they have no narcotic or other poisonous juices to be boiled out of them, as many of our culinary plants have; and, therefore, though it cannot be said that the rude man finds bread and flesh on the tidal beach, yet the fuci, and the mollusca and crustacea, furnish better substitutes than are any where else to be met with by men who have not learned the culinary art.

But besides these, every tide which rolls toward the shore brings with it a supply of fish from the all-bountiful deep; and some of these are left in the pools and crannies of the rocks, when the tide again ebbs away. These are a new resource; and one can easily understand that the transition from catching a fish left in a pool by the tide, is neither great nor difficult to be made. In this way, the rude man becomes as expert in the water as he is on the land. Probably his first step is to dive for shelled and crusted animals, and the next one is to try the capture of fish in the same manner. But the extreme voracity of the finny tribes very naturally suggests the enticement of them by baits. There are weeds or fibres of some kind, tough enough for a line; a shell is ground to a hook upon a stone, and if that hook is of a pearly shell, it serves also as a bait for many species of fish. One step more, and man is at sea astride a log which he sees floating, and furnished with his fishing-hook and spear of a pointed stick; nor is it long before the canoe is formed, and the fiz-gig and turtle peg are added to the list of his piscatory apparatus. Man has now something that he may call his own,—something to which he has a desire to add, and a desire, of which every gratification is the fertile seed of another desire; and he stops not till the globe is circumnavigated, and the produce of every region, and knowledge of the arts to all who will receive them, are distributed over every shore; and Heaven itself crowns the triumph of improvement, by proclaiming life and immortality to the remotest isle of the sea.

If we had time to dwell upon this as our principal subject, we should find it fraught with information of the most important kind; and this alternately flooded and exposed beach would point out to us both the inducements and the means by which mankind are enabled to bring themselves forward in civilization. One little point, however, we cannot pass in silence: we have hinted already, and whosoever will, may carry the hint onward to full demonstration, that man could not have taken his proper rank in the scale of the world's inhabitants, had he been restricted to the land only; and had he been restricted to the sea, he could not have existed with his present organization; which is tantamount to saying, that he could not have existed at all. As there is no particular locality upon the earth, mountain or plain, wilderness, woodland, or savannah, which can be referred to, as more than another the place of man, unless we take along with us an element which does not belong to man, considered merely as a member of the animal kingdom—the occupation which he is to pursue there; just so, when we look at the two grand constituent surfaces of the earth—land and water—we cannot assign his place and his occupation wholly to the one, or wholly to the other. He is *per terram per mare*, both for the land and sea, and the dominion of his understanding—the field for his inquiry and his exertion—extends over every portion of the planet he can reach, be it solid or be it liquid.

True to this, which is obviously the behest of the

Creator to our kind, all the nations by whom the truths of science have been discovered, and the contrivances of art carried into execution, have been men whose territory abutted on the waters, upon the ocean shore, or on the bank of some wide rolling river. The Nile, the Euphrates, the Ganges, the shores of the Mediterranean and the Archipelago, have been the places where Science has been cradled, and Art born. Therefore, every one who has understanding and feeling, will approach the waters with a more sacred and more uplifting throb of the heart, than he will approach any other portion of the earth's surface.

And while we feel the force of the general principle, we must beware lest we forget the heavy debt of gratitude which lies upon us as Britons, for that the kindness of the Almighty has bordered and blessed our country with the living waters in its full circuit, and has prepared the pathway of the deep to every point of our shores, and cleft our tidal estuaries far into the bosom of the land, so that, ere the sun in his apparent course has thrice girdled the zone of the heavens, man may strike hands with man, in pleasurable intercourse, or in profitable commerce, from the most distant ports of our country ; and that all, as occasion requires, may go freely abroad over the wide world, as the comparatively near neighbours of the inhabitants of every shore. And, as we are the neighbours, let us improve our privilege, and be at the same time their friends.

CHAPTER VI.

SUMMER ANIMALS BY THE SEA.

In various parts of the world, especially those in high latitudes, where a frost wind from the polar ice or the snow-clad lands, sweeps over the surface in the winter, there are many animals found at the surface during the summer months, which spend the inclement season at a greater depth. Many of these are too small for being seen by the naked eye, and probably some of them are not discernible by an ordinary microscope; but still, if we take up water from the open sea in the Summer months, and boil it, we invariably discover in it that peculiar odour which is given out by the invertebrated animals of the deep, and which, like the peculiar odour which distinguishes animal matter, when burned, from matter of any other kind, can never be mistaken, after it is once known. There are also many races of fishes, which disappear from the surface of the broad waters in the winter, and make their appearance again in the warm season; and they, in all probability, are sent to a greater depth in the winter, both by the cold, and in order that they may follow their food. The reversal of both of these,—the influence of the more direct and longer-continued sunbeams upon the surface, and the ascent of the animals upon which they feed,—no doubt, tend to fetch them up in the warm season. These can, however, be observed only by those who make voyages on the sea; and, if even they get more than a passing glance, the voyage is a lingering one.

But if we are to speak of animal displays in Summer, as connected with the sea, in such a manner as to make what we say available to the majority of readers, more especially of young readers, we must confine ourselves to what is to be seen on the shores, both upon the dry land, and the tidal surface, and the offing, as far as the last can be seen from the land. Even when we do this, our subject is one of no common magnitude. Taking all the shores of the sea, in all their variety, they would be too much for any one work; and even if we restrict them to the average of what is to be found in such a country as Britain, they are still too extensive for any sketch, and all that we can accomplish is to notice a point here and there. But even if we had scope, and the reader had patience to enter into minute particulars of all the creatures which are found by the sea-side in Summer, the children of nature, which resort to that most productive portion of the surface, would not nearly all be included. There are curious alternations of animals on the shores of the sea, in regard to their seasonal appearance there. Of those which are organized for migration,—and they are the majority of the vertebrated animals,—there are few which monopolize the same locality all the year round. This portion of nature is in fact too productive for being permanently given over to any one family or class of wild animals; and therefore, some resort to it at one season of the year and some at another. Thus, for instance, many species of birds, which distribute themselves over the inland moors and marshes, or resort to the high latitudes, during the Summer and the nesting season, descend from the high grounds, or migrate from the high latitudes when the severe weather sets in. These find both warmth and food on the shores during the winter, and, as the season advances, they again take their departure, and give place to others. There are a few land birds which remain by the margin of the sea, nestle there, and pick up their food on the tidal beaches; and as they are, generally speaking, neat in their plumage, swift on their feet, and have shrilly and piping voices, which are heard above the soft murmur of the Summer surge, there is a good deal of interest about them.

These, however, are by no means the characteristic Summer birds of the sea. No doubt they have their interest, the more so that the chief places in which they are found are, otherwise, places of apparent desolation when the tide retires, being the broad flat beaches of sand or shingle. But we must not deceive ourselves with appearances in this matter; for the sands of the sea, even though quicksands fatal to man, or such of the larger animals as might attempt to pass, are not alone in their apparent desolation, like the inland sands of the tropical deserts. Twice in the day, or at least in a period not much longer,—and the continual shifting of this period gives additional variety and additional fertility by varying the flood and the ebb to all hours of the solar day,—twice in this time, the sea comes over the sand or the shingle, bringing along with it food for a vast number of creatures, of whose existence there is hardly a trace left at low water. These creatures partake of the extreme productiveness of all the inhabitants of the sea; and the shelled mollusca, the crustacea, the annelidæ, together with various species of small fishes, which bury themselves in the sand as the water retires, rise up when the returning tide floods their habitations, and not only find an ample supply of food for themselves, but give the exuberant surplus of their numbers as food for other races; nor must we fail to bear in mind that this supply of food, which the rising tide fetches out of the apparently barren sand, brings within the reach of man, in situations where he can capture them with ease and certainty, many valuable species of fish, and, among the rest, that prince of the waters, the salmon. Thus, though we can decide with some certainty as to what is productive and what is sterile on the land, we must pause and examine well, before we predicate sterility of any surface over which the waters of the ocean pass, at least till we reach a depth beyond all surface and seasonal action, and utterly beyond the range of human observation. Whithersoever, indeed, we turn, and contemplate the liquid element, we find that the primal command, "Let the waters bring forth abundantly," is still fully and habitually obeyed: and here, as everywhere else, we have demonstrative evidence that man, trusting to and guided by his own weak and erring judgment, is the only rebel against the laws of material nature, and that even he is physically so constituted as that he is constrained to obey very many of those material laws, how much soever he may err or fail in observance of the moral ones.

The grand gathering of migrant animals to the Summer feast of nature, on the shores of the sea, is from the sea itself, whether those animals are birds or fishes. The greater part come for physiological purposes, in order that the race may be kept up, and a surplus left for whatever other race may require it; and such as do not require to come to the shores or the shallow waters for this purpose, come following the others, in order to feed upon them. But notwithstanding the multitudes of these destroyers, whether aquatic mammalia, or birds, or fishes, such is the extreme productiveness of the sea, that all have plenty, and there still remains as much of treasure from the all-prolific waters as man can gather in by the utmost effort of his industry and skill.

After the broods are reared, and the grand purpose of nature is accomplished and secured for the season, the sea-birds disperse over the breadth of the waters, and few or none are found, even in the vicinity of those places where they congregate in thousands in the breeding season. Some of them are simply scattered along the shores, where they pick up those substances which the violence of the autumnal and winter storms brings to the beach; but the greater part migrate into warmer climates, or are scattered singly over the expanse, until the stimulus of a new season recals them, when they return to the same rock with the same certainty as a house martin returns year after year to the same angle of the same window. Before, however, we can enter into a profitable examination of these migrant animals, which congregate upon the shores in the Summer months, there is another question to be asked and answered, namely, from what they derive their supplies of food. This is a matter of the first importance in the general inquiry, and it is one upon which there can be little or no appeal to the winged race, as they come to the shores, not as food, but as feeders. It is true that some of them, as, for instance, the gulls and the skuas, are sad plunderers of nests; but, taking the shore-building birds in the aggregate, they do not support each other; and, therefore, we must seek somewhere else for the grand cause of the Summer productiveness of the littoral portion of the sea.

There is some difficulty in obtaining a proper foundation for our inquiry here. On the land, we know that the vegetable tribes are the primary supporters of the whole of growing and living nature; that, in their decomposition, they nourish other vegetables, and, in their undisintegrated substance, they feed animals; that these vegetable-consuming animals in their turn feed the animal consumers; and so on they proceed, race supporting race, till we get through the whole system. But in the waters, and more especially in the sea, there does not appear to be a sufficient production of vegetables for being the basis of the system. Various fishes eat sea-weed, although it is doubtful whether many races, or indeed any, live exclusively upon it; and of the countless myriads of small animals which inhabit this weed, whether adhering to the rocks and stones, or floating in the eddies of the water, there are, in all probability, many which subsist upon it. But even if we take this foundation of food in the marine vegetation, at the very utmost latitude which we can give it, it falls far short of what the first stage of animal life in the sea would require, in order to support the other stages.

So far as we can infer from the other parts of a chain of being, of which we are unable distinctly to see the beginning,—the link which connects it with inorganic matter,—it is probable that, if not the very beginning, at least the most early and rudimental portion that is open to our observation, even with the assistance of our best instruments, is animal. We know that in fresh water, the rudimental animals, the *Infusoria*, or *Animalculæ*, as we call them, are extremely minute; and we know nothing about their feeding, or the substances upon which they feed, until we come to so advanced a stage as that we can observe the larger ones eating up the smaller. This we find only in liquids; and therefore the analogy would lead us to suppose that the primary support of animal life in the sea is something of the same kind; that the water is full of living creatures, of extremely small size, and that it is not till after a number of successions of the larger eating the smaller, that they come within the scope of our senses, or even of our instruments. This very minute part of the system is not, however, of a popular nature, any farther than that it is necessary to have some glimmering of knowledge as to where or in what the wonderfully prolific chain of animated nature, which we find in the sea, may have its beginning.

But after we get a conjectural glimpse at this beginning, there is ample scope both for our study and our wonder, in that which we can actually see. We may pass over the countless myriads of little creatures which we find leaping about, at the water-line of the sandy beaches, and also the small crustacea which are found among the stones and in the little tufts of sea-weed where the tidal surface begins to be of a more substantial and stable character; we may pass over these, and turn our attention to the rocky shores, upon which sea-weed grows luxuriantly, where the tide covers the surface for a considerable time, but where the more elevated parts which are merely washed with the spray, have no decidedly marine vegetation. In the early part of the season, a pin's point can hardly be put down without touching a young animal of some one species; and the young shells of one kind or other are absolutely countless, while in every little pool which has been left by the tide, crustacea swarm in myriads, and the shadowy parts of the rocks are covered with innumerable zoophytes, naked or covered, displaying themselves as stars, and flowers, and branching twigs, and in more shapes and forms than fancy can picture. Among these there is an almost endless variety of modes of life, and modes of production; but the latter, whether it takes place in one way or in another, is immense in all the races; so that though they afford subsistence for countless thousands of other animals, their own numbers are not a jot diminished, but appear to keep up, not so much for the sake of the individual races, as for the preservation of the grand balance of the system of nature. The numbers of such animals found upon our own shores exceed all powers of arithmetic; and yet they are nothing in comparison with those of the shores of the tropical seas, where production of this kind goes on at all seasons, and reaches to a far greater depth than with us. In this matter of depth, and also in the supposed transparency of the water, we are very apt to be deceived by the differently illuminating power of the sun, as the angle at which its beams fall on the surface varies. In tropical climates, where those beams strike perpendicularly into the water, they illuminate to a great depth; so that one accustomed to look on the sea in high latitudes, would be apt to suppose the bottom not beyond his own depth, when in reality it is ten or twenty fathoms. In very high latitudes, again, the slanting beams of the sun penetrate so short way into the water, that, supposing equal transparency, the bottom itself cannot be seen at the same depth at which a pin at the bottom would be distinctly visible in an equatorial sea.

But this, instead of diminishing the effect of the Summer action in the seas of the high latitudes, is really a means of increasing that action; for, by being confined to a much smaller depth than in the tropical regions, it is concentrated near the surface; and the stimulus in the shallows, and also in the surface portion of the deep water, is great in proportion. This is also farther increased by the greater length of time that the sun is above the horizon; and when we come to latitudes so high as that the sun never sets, we have an almost continuous action of small life in the Summer, alternating with an equally conspicuous repose of it in the winter. The number of sea-birds and marsh-birds which resort to the high latitudes to partake of this bounty of the Summer, is immense; but still they all find abundance for themselves and their broods.

We are thus to understand, that the vast productiveness of the margins of the sea, in invertebrated animals, during the Summer months, is one of the principal means by which the vertebrated animals, which collect there in such vast numbers, are enabled to find their food. But it is not the only means, for the characteristic animal production of the sea is in the fishes; and, therefore, no one who is not at least a little acquainted with their economy, can look upon the sea with eyes fitted for drawing from its wonderful expanse that flood of knowledge and of pleasure which it is so well calculated to supply.

This is a maxim which, above all others, we are anxious to inculcate, that the observation or the study of every subject should be approached only with a knowledge of *all* the elements; for, if even one is unknown, the values of all the others are indeterminate; and thus there is no certainty of arriving at a just conclusion, and every probability of the opposite. Upon a subject so complicated as the sea, this is especially necessary; and if there is any one kind of locality which, more than another, is calculated to stimulate mankind to the study of nature, and to expose and reprove their ignorance if they have not, it is the shore of the sea. Upon the tops of the cliffs, and in their fissures, we generally find a land vegetation different from that of the interior; and it is in the cliffs themselves that we can best and most easily learn the nature and the arrangement of the solid parts of the earth. Then the productions of those parts which the ebbing tide discloses, and the ruins of the deep which are cast ashore, taken in conjunction with the others, render the margin of the sea a natural museum of no common richness and variety. It requires a wonderful deadening of the natural feeling of mere curiosity,—that feeling which, in early life, seeks for knowledge without the stimulus of a "why,"—to prevent the young from putting questions relative to the wonderful novelties which they meet with on the beach. A parent, for instance, who pays a Summer visit to the coast, along with his family, must, if ignorant of the productions and the economy of the sea, live in continual dread lest his children should question him; and, as there is nothing more humbling to a parent, or more calculated to lower him in the estimation of his children, especially at the candid age before their minds have been moulded after the paternal model, than that he should have to show his ignorance, the gates of knowledge are often most studiously shut upon the child, lest the ignorance of the parent should be seen through them.

This appears to be one of the chief reasons why those persons who annually resort to the watering-places, know so very little about the sea and its productions. On their return, all the members of the family are learned and garrulous enough about the company that were there, and the dresses, the amusements, and their own adventures and perils by field or flood,—the most alarming part of which may probably have been, that some were a little retchy, and others in great peril of drowning, in consequence of the sea-breeze curling the ebb, and there being actually as much white foam upon the water as would have filled an ordinary basin. We do not mean to deny that some individuals who resort to such places, do know and enjoy the sea. But if there is any such, it is in vain to seek him on the promenade, or at any of the fashionable lounges; and, if there shall happen to be a "lion" at the place, the man who knows and loves the waters and their productions, is sure never to be he. He is to be found alone, or at most with one chosen companion—haply with an aged fisherman, who has been familiar with the deep and its productions for seventy Summers and winters; and at grey dawn and dim twilight he is on the beach, because, if the state of the tide is favourable, these are the times of the day at which the subjects of his research are in greatest activity, and their manners most easily learned. But still, a mere hunter after the curiosities of the sea is only a trifler,—a different kind of trifler, indeed, from those who retail the gossip of the lounge, but still not the less a trifler.

In order that any one may enjoy the sea, or even the shore with the proper zest, it is necessary to know something of the sea in its extent and in the seasonal economy of its inhabitants; for without this, the sea itself is as complete a blank to the understanding as those great depths of it which no line can fathom are to observation. Now the fishes are the characteristic living inhabitants of the sea, the most useful ones to man, and also the most exclusively aquatic as a class; and therefore, whether our opportunities will admit of our having much knowledge of the other marine productions or not, it is especially necessary that we should know something about fish. The paramount importance of this class is proved by the fact, that all living creatures inhabiting the water are called fish, whether they actually happen to be fish or not. Thus, the *cetacea*, or different races of whales and dolphins, the largest and the most powerful natives of the sea, are called fish, though they are in reality mammalia, or warm-blooded animals, bringing forth their young alive, and suckling them with milk. These animals are organized for progressive motion in the water, no doubt, and they are habitual dwellers in the free waters, and do not require to come seasonally to the shore, in the same manner as very many of the fishes do, though they do occasionally, especially in the smaller ones, pursue those fishes on which they feed close to the shores, or up the estuaries of the rivers. But if any one watches their motions, as for example the motions of the common porpoise, following the salmon in their movements river-ward, or any other kind of fishes, one can perceive in it the general motion of a land animal, though the external form resembles that of a fish. The flexure, or principal bending of its vertebral column or backbone, is upwards or downwards, while that of the fishes is from side to side. Hence it pursues its prey by leaping; and though only the fin, or the fin and a part of the back, may be seen at the top of the leap, it is a species of motion which is never seen in any true fish, numerous and varied as these animals are. It is on this account that "tumbling like a porpoise" is a proverb among those people who are familiar with the economy of the sea.

It is customary also in common language to include, under the general name of "shell-fish," all the marine crustacea, such as lobsters, crabs, and shrimps; and mollusca, such as oysters, periwinkles, and limpets. But the first of these have what may be considered the bones on the outside of their bodies; and in their composition, these crusts hold an intermediate place between the internal bones of vertebrated animals, and the external shells of the mollusca, to which latter no organ of general motion to the animal is attached, but merely, in the case of a bivalve or double shell, muscles and elastic ligaments for opening and shutting the shells, so that these may at one time admit a free passage to the water, through which the animal may breathe and feed; and at another time they may be closed up as a sort of fortification against the attacks of enemies. Even in the strongest of those fortifications, there is, however, no security; for, as the general law of nature is, that one portion shall support another, there are other animals, generally also mollusca, with a single spiral shell, provided with apparatus by means of which they can bore through the thickest protecting shell of their bivalve neighbours, and speedily extract all the substance of their bodies. Boring animals of this family are peculiarly destructive of the beds of muscles; so that, where they are numerous on the coast, there are hardly any muscles to be seen. When the workmen began to erect the splendid light-house on the Bell Rock, in the offing of the Tay, which has been the means of saving so many lives and so much property, esculent bivalves were found in great numbers by the men at low water; but in the course of the work, one of these boring animals, *purpura lapillus*,—the common rough white whelk, we believe,—was introduced by some of the vessels bringing the materials from Arbroath. It multiplied very fast, and the esculent bivalves gradually disappeared. Both this and *buccinum adnatum*, which resembles it in many particulars, but is larger, and inhabits deeper water, are so destructive, that muscle beds for affording bait to the fishermen cannot exist on those parts of the shore where these are abundant. In some places, the men make artificial beds of muscles in inclosures, from which the destroyers are excluded; but they more frequently make reprisals, by catching the buccinum itself in basket traps, baited with carrion and offal, in a manner similar to that followed in catching crabs and lobsters. All the crustacea and mollusca of the sea, which have the power of locomotion, and are of considerable size, are indiscriminate in their feeding; and though they devour a number of living animals, they act the part of scavengers, much in the same way, or, at all events, to the same extent, that vultures, beetles, ants, and various other animals, both vertebrated and invertebrated, do upon the land. If we wish to have the skeleton of a mouse, or any other small animal perfectly cleaned, without injury to the most delicate bone, the surest way is to place the body of the animal near an ant-hill; and the small crustacea will very speedily perform the same operation, if the body of an animal is placed in the sea. Skeletons of the white falcon of Iceland (*Hierofalco*), which furnish the finest instances of symmetry, strength, and lightness, and are perfect studies for every one who wishes to learn the principles of mechanics in the school of nature,—the only school in which they can be learned to perfection,—are speedily obtained upon the shores of that inhospitable but singular island.

There is one remark more on the composition of bones, crusts, and shells, which is worthy of attention, though no positive conclusion can, in the present state of our knowledge, be drawn from it. The internal bone, in so far as it is earthy matter, is composed of phosphate of lime; the crust, of carbonate and phosphate jointly; and the shell in great part of carbonate. The bone and the shell grow with the growth of the animal; and, though there is in all animals a power of repairing them when they are injured, very few can replace even a single bone when lost. With crusts it is different: they are changed every year at least, for several years of the life of the animal; and thousands of these empty crusts may be gathered on the beach every season. How an animal of such complicated structure as a crab can extricate its body from the crust, is a curious matter; but it is not more curious than true, for the cast-off crusts are empty to the utmost ramifications of the legs. Some of the more remote parts are, no doubt, absorbed or withdrawn into the mass of the body; for all crustacea, which thus cast their crusts, have the power of reproducing a member, if it happens to be broken or torn off; and the latter is said to happen frequently among the lobsters, in their wars during the breeding season. But the members which are thus broken off and reproduced, never attain the same size as those which remain on the animal from the commencement of its existence; and this appears to be the reason why we find crabs, and especially lobsters, with one of the pincer claws much longer than the other.

These animals of the beach, or at most, of the bottom, where the water is not of very great depth, have enough of interest in them to detain us for a much longer time than we can devote to the whole subject; and we have mentioned them chiefly for the purpose of showing, that those who resort to the sea need never be without pleasure and instruction from nature, on the tidal beaches; and we may add, that those beaches, just as the ebbing tide leaves them, are exceedingly healthy and refreshing during the Summer's heat—far more so than any others to which the visitor can resort, while to one from the inland parts of the country, they have most novelty and attraction. But still, whatever is met with there, unless it happens to be imprisoned in a pool left by the tide, is not characteristic of the sea, but of the sea and the land jointly; because all these creatures, though capable of swimming, if they have any locomotive powers at all, are also adapted for walking on the bottom, or crawling about or adhering to the rocks. They are, therefore, in so far, land animals, as that they rest upon the solid surface, or the plants growing on that surface, just in the same manner as birds rest upon the earth or the branches of trees; and the swimming of the one may be, though in an inferior degree, as being performed in a denser element, compared to the flying of the others in the air. Therefore, if we are rightly to understand the economy of the sea, with regard to animal life, whether general or seasonal,—and we cannot understand the second without some knowledge of the first,—we must direct our attention to those animals to which the water itself is a continual dwelling, a resting place, as well as a feeding pasture.

There are several classes of animals which make the sea their constant abode in this way, and which never are found on the shores, unless when lost and shipwrecked there, which they often are after storms. Among the most remarkable of these are the *Cephalapode* mollusca; that is, those which have the organs of motion and prehension surrounding the mouth, and which swim with the mouth downwards, as, for instance, the cuttles,—very inaccurately termed "cuttle-fish" in common speech; and some of the *Acalephous* zoophytes, such, for instance, as the *Medusæ*, many of which appear to be little else than a thin bag filled with gelatinous liquid, which liquid is often of so caustic a nature, that the touch of it blisters the skin, and occasions very sharp and irritating pain. In the warm seas this property is often highly virulent; and some species which are cast on our own shores, which they very often are by storms, are so pungent, that the dried powder of them, applied to the skin, is highly tormenting. But wonderful as those creatures are, and almost endless as is their variety, they are still not the characteristic animals of the ocean, taken in the volume of its waters, for they are in a great measure surface animals, and, from their forms as well as the consistency of their bodies, very much at the mercy of the currents, so as to be moved about on these, in whatever direction they may set. We must look for the modification of life which is especially typical of the sea, not at the bottom, or the surface, or as in any way restricted to locality in the class, but as having full range and being at home, from the shore to the mid ocean, and from the surface to the greatest depth at which life can exist; and here our attention is at once and forcibly drawn to the FISHES.

The fishes are perhaps the most extensive, the most interesting, and the most intricate class of animated beings; and though their home is a wide one and free to their range, we cannot, in the nature of things, know much of their habits there, farther than as they reveal themselves by coming to the surface or the shores. The abode of a fish in the sea, especially when its habit is to dwell at the depth of fifty or a hundred fathoms, is one of which even our imagination is exceedingly vague. Every one must be aware that the pressure of water increases with the depth; and that a cubic foot of sea water weighs about sixty-three pounds of our common weight. If the depth is fifty fathoms, or three hundred feet, the pressure on a foot of surface is very nearly nineteen thousand pounds, and it is the same in every direction, upwards, downwards, and laterally.

Water is scarcely at all compressible by pressure, at least by any degree of pressure to which it has been experimentally subjected; and thus, though the bottom fish may have three hundred times as much pressure on its body as a fish of the same size has at the surface, yet its motion through the water is not a bit retarded. We find evidences of this compression in deep-sea fishes; for, when a cod is suddenly drawn from the bottom to the surface, the internal expansion, arising from the removal of the pressure, often turns its stomach inside out: this shows us, that no one species of fish can command the full range in depth of the deepest parts of the habitable ocean; and, consequently, that those which migrate seasonally from the deeps to the shallows, and back again, for seasonal purposes, must do this gradually. As they are generally in the best condition when they come from the deeps, enterprising fishermen, if they can afford the requisite expense of apparatus, may thus go out and meet them long before they arrive at those grounds where the shoals disperse, in order that the eggs may be deposited over a wide extent of that portion of the water which is exposed to the action of light and heat; which appear to be necessary both for maturing the eggs, and for stimulating them into active life after they are deposited. This is the real cause of those seasonal movements of the fishes, whether of the sea or of the lakes and rivers, which bring them within the reach of man when they are in the best condition for food, and carry them without his reach when they are unwholesome. Those movements, though to a less conspicuous degree in consequence of the comparatively uniform temperature of the water, are in reality as much produced and governed by the variations of the seasons as any of the products of the land; and the action of the same sun which produces and prepares a loaf of bread for man, produces a fish for him to eat along with it; and there is this difference between the two productions,—man must plough and sow, and tend his grain crop upon the land, whereas he has nothing else to do but gather in the harvest of the sea.

The second subject for our consideration is, how the fishes inhabit in the sea, what labours they have to perform, and what of advantage they have to assist, or of disadvantage to hinder them, in the performance of these labours. This is, in every respect, a difficult inquiry, and in many respects it is little better than a conjectural one. The experience which we already have is our only sure guide to the knowledge which we seek; and here, all our experience is in the atmosphere; for even when we descend in diving-bells and other apparatus, we are still in the air, not in the water; and therefore our knowledge of action, and also of the stimuli of air, heat, and light, is confined to these as they are displayed in the air itself.

With regard to the absolute depth to which the stimuli now mentioned penetrate the dwelling of the fishes, and the quantity in which they are displayed, we have no positive information. The tendency of air to diffuse itself through water is great; and, as the fishes which inhabit lowest down have breathing apparatus as well as the surface ones, we may be sure that there is air at the greatest depth at which any animal can live. The air must also differ in its character with differences of depth. Air is very compressible, and therefore the deeper it is in the water, it must be the more dense. In consequence of this, a proportionally smaller volume of it must suffice for the purpose of respiration; and the condensing of it must set free a certain portion of the action of heat; and thus, the deep inhabiting fishes cannot only subsist with less action of respiration, but they derive a certain degree of the stimulus of heat from the very pressure of the water over them. The more substantial air, so to express it, which they separate from the water at those great depths, necessarily demands more compactness of structure in their breathing apparatus, than is required by fishes which inhabit near the surface; and this is one of the reasons, though not the only reason, why they are more tenacious of life.

Of the depth to which heat penetrates, we cannot speak with certainty; but as it is less refrangible and less reflectible than light, and acts more upon the substance, and light more upon the surface, it is probable that it penetrates with more effect than at first sight we would be led to suppose. The temperature at considerable depths is, however, very considerably lower than at the surface; for as there is action in a fish, and comparatively none in the water which it inhabits, we may naturally conclude that the fish is a little, though only a very little, warmer than the water in which it is found. Now it has been ascertained by actual observation, that the fish drawn from a depth of about forty fathoms, on the great bank of Newfoundland, have sometimes a temperature as low as thirty-five degrees, when that of the water at the surface is above sixty; but the experiment here is not quite conclusive, inasmuch as the expansion of a fish brought from the pressure of forty fathoms of water, must tend very considerably to reduce its temperature. Our knowledge on this part of the subject is very vague; but as the greater number, and probably the whole, of the migratory fishes, resort to the deep water to recover their flesh and vigour after spawning, it is highly probable that the temperature, and all the other circumstances there, are the best adapted for promoting their individual vigour and growth. There is another circumstance in favour of this: all fishes permanently resident in shallow water are of small size, whatever part of the world they inhabit, and whether they inhabit the fresh water or the sea; while larger ones, even of the same species, are found in the deeps. We have an illustration of this in those small rivers which come more completely under our observation, than the extended and deep waters. The minnow, for instance, is found in the shallow runs, while the large trout occur only in the pools.

In this there is a very obvious analogy to what we have said of the vegetable races. The increase of the individual plant is greatest, while the influence of the light and heat is at a maximum; but the maximum, if not excessive in proportion to the humidity, is favourable for flowering and fruiting. So strikingly is this the case, that in seasons which are extremely humid and cloudy, the product of the fields is much straw and deficient corn ; and that of the other vegetables, an exuberance of leaves and a paucity of flowers and fruit. But if the Summer is of the opposite character, and not carried to an extreme of drought, the ear of the corn is full, and flowers and fruit are abundant, while the straw and the leaves are both deficient in quantity.

It is the same in those migratory fishes; when they are removed from the solar and atmospheric action, there is a vigorous growth of the individuals, and comparatively little tendency to reproduction; whereas when they come to the shores or the surface, so as to enjoy an increase of solar and atmospheric stimulus, their reproductive system is called into more vigorous exercise. It is this which constitutes the Summer action of the fishes; for it is the Summer action of all living and growing nature; and the season at which the fishes come to the influence of the sun and the atmosphere is their Summer, at whatever time of the year it may take place according to the calendar. It is to be understood that this grand Summer action tells upon the parent fishes themselves, just as the Summer action of vegetables tells upon those by which the flowers are produced; for both the egg of the fish, and the seed of the plant may, and generally do, have a certain inactive power, before the new life is stimulated to vigorous development. Thus we see that, in all places, from the highest level at which a lichen will grow, to the greatest depth at which a plant can live or a sea-weed exist, there is one law to every race of being, animal and vegetable; and there is a double action,—one degree of stimulus promoting the growth of the individual, and another and a higher degree promoting its fertility. The first of these is what we may properly call the spring action, and the second the Summer action. But in long-lived animals or plants, the full grown individual may be the growth of many springs, and it may yield, by its productive power, the abundance of many Summers.

With regard to the distribution of light to the fishes in the deep waters, we can know but little. It must be darker there than at the surface, but how much darker we cannot tell. There are many animals which have what are called phosphorescent properties, and can light up their own candles in the deep; but the majority of them are small ones and near the surface, and we have no means of ascertaining how far they contribute to the general illumination of the deep, or whether they contribute to it at all.

There is one circumstance connected with the distribution of light under the surface of the water, in which we run some risk of being deceived by appearances. It is in obtaining an answer to this question,—When the surface of the water is rippled and broken, it always appears darkest to us, and we see to the least depth into it;—is that the time when the volume of the water is darkest to the fish? One who had not carefully considered the matter, would be apt to answer this question at once in the affirmative; and yet it is very doubtful whether the true answer is not the very opposite. We have reason to believe that the fishes which feed in the free waters upon prey floating on those waters or upon their surface, depend on the sight much more than on any other sense, in the finding of their food. Scent can have but little exercise in the water, as is proved by the baits, and imitations of baits, at which fishes bite readily; and hearing can have as little, the more especially that the food of fishes in general moves silently through the water. The free swimming fishes which inhabit very deeply, also have the eyes very large and perfectly developed; and it is only the mud fishes that have the eyes very small or wholly wanting. Tasting is not a sense that guides any animal to its prey, and fishes appear to possess it in a very low degree. Touch too, that is, what is usually called touch, is not a sense that operates except on actual contact; and therefore it cannot guide a fish to prey at a distance from it in the free waters, however useful it may be to a fish at the bottom, or otherwise in contact with its prey. All these circumstances, and others that will readily occur to the reader, tend strongly to prove that all the fishes of the free waters depend greatly on their sight in finding their food.

But every one who has paid attention to fishes in those places where they can be best observed, that is, in rivers and ponds, knows very well that they are most on the alert, and disposed to take their natural food, or bite at the bait of the angler, when the surface of the water is agitated; and the advantage of a curled surface is so great in fishing for mackerel, which swim near the surface when they approach the shores, that a light but brisk Summer wind, which just curls the surface, without producing actual waves, is proverbially called a "mackerel breeze."

In equal degrees of light acting on the surface, is the water darker under the ruffled surface, or is it lighter? If equal light falls on the surface, the quantity (we speak not of quantity of matter, but of action,) which enters into the water, must be inversely as that which is reflected from the surface of the water. But the air over the tranquil surface of the water is always more illuminated than it is over the ruffled surface; and thus it is certain that more of the action of light enters the water under that surface. Less also comes back out of it; for the surface is dark-coloured, and the bottom is not seen, even though there be no foreign substance mixed with the water. Now, the strong reflection of light, out of any medium, though it may be, and certainly is, the means of seeing much better into that medium, is not the means of seeing better either within the medium or out of it, but in all probability the reverse. It is true that trout, and various other fishes, are alarmed by shadows moving over the tranquil surface of the water; but we are not certain whether they are more or less affected by similar shadows when the surface is rippled, because in that state of things their movements are hidden from us. It is generally supposed, that angling when the surface is rippled is much more successful than when it is smooth, on account of the ripple hiding the angler and his tackle; but in the case of a natural fly upon the water, there is no angler and no tackle to hide, and yet the same kind of surface is equally favourable for the fish rising at the natural fly and at the artificial one. The probability therefore is, that the food, or the bait, as it may happen, is better seen when the water is thus ruffled, and that, in the case of no foreign admixture, when the water is darkest to us, it may be lightest to its own inhabitants; and that the fishes may not dwell so darkling in the deep as those who are fond of expatiating on the subject, rather than inquiring into the philosophy of it, are apt to suppose. There is, however, one little difficulty in the matter: light and heat are so intimately connected, more especially in the direct beams of the sun, and perhaps so identically the same, though affecting different substances in different manners, that the solar action absorbed by the ruffled surface of the water, above what is absorbed by the smooth and glassy surface, may, for aught we know, be transformed into the stimulus of heat, and affect the fishes in that way. This would be agreeable to a very general law of nature; for, in as far as action in the individual for itself is concerned, an extreme degree of light is not the most favourable. But how widely soever we may extend the range of our inquiry, we never can arrive at any very certain conclusions with regard to the degree of light and heat which the fishes enjoy in deep water. There is no doubt that it diminishes with the depth, but in what proportion we have not the means of ascertaining.

It only remains, upon this subject of the general accommodation of the fishes in the water, to consider what labours they have to perform, and what advantages or disadvantages their peculiar element gives them in the performance of those labours. The often-quoted observation, that "the fishes have nothing to do but enjoy themselves in eating one another," naturally occurs to the mind here; for all that they have to do in supplement, is to move to where they may eat, and from where they are in danger of being eaten; and we shall presently see that, independently of the way in which they are formed and organized for their respective kinds and rates of motion, they have great advantages over all animals that inhabit the atmosphere, whether those animals walk, or climb, or fly.

It will be borne in mind, that every land animal, how light and buoyant soever it may be, is always so much heavier than its bulk of air—that it is constantly burdened with a weight. In fact, it is the difference between the weight of the animal and its bulk of air which we, in common language, call its weight. If it walks, it bears this weight upon its feet and legs, and thus they have a double office to perform—supporting the animal, and enabling it to move. If it flies, a still greater exertion is required in the organs of flight, because these have to keep it up and propel it with the very same motion. Mammalia and birds, therefore, require strong bones to support themselves, and afford insertion to the muscles which work their organs of motion. But it is a general law, running through the whole system, that where there is much working of a material structure, there must be much wearing; and, in order to keep the system of a hard-working animal in proper tone and vigour, there must be replacement and repair, proportionate to the waste and exhaustion. But the repairing of an animal can be performed only by the working of its own system, in a more vigorous digestion, and especially a greater quantity of blood, and a more rapid circulation. This internal working portion of the animal is by far the most nice and delicate part of its wonderful frame; and, therefore, it must wear even more rapidly than the external system of motion. This is the reason why land animals become stationary in their growth after a certain period, and after another period, decline and die of old age, even though no contingency befalls them. There are great differences in this respect; and we cannot say that the law is exactly the same to the three vertebrated classes upon land—Mammalia, Birds, and Reptiles; for it appears to be more determinate in the first than in the second, while the limit both of life and of growth in the reptiles, is longer in being reached. The fact is, that, contrary to what we might at first suppose, those animals which eat voraciously of nourishing food at long intervals, and pass much time in a state of inaction, continue to grow and to live for the longest period. Thus, it appears to be true, that the very same law which we find in the mechanics of dead matter, holds true in the mechanics of living matter, that is, of matter under the influence of living action; namely, that what is gained in power must be lost in time. But this is absolutely true in the different races only, and not in different individuals of the same race; for an indolent animal falls within another statute of nature. Where a certain degree of active power is given, if that power is not made to work usefully, it will work for mischief; and hence, an animal of a very active nature never lives long in close confinement, though it be tended and fed with ever so much care.

Such are the general laws of action with regard to all terrestrial animals, whether they require to start from a solid support at every step or bound which they take, or gain fresh impulses in the air by means of wings. Let us compare with them the action of fishes in the water.

The specific gravity of the water is so very nearly the same as that of the fish, that the fish may be said to have little or no weight to carry; and this makes its labour light, as compared with that of land animals. For the very same reason, the fish has no need to go to a resting place; for it has only to suspend its motion, and to repose upon the elastic bed of the water, whenever it requires. Then, this is a bed of a far more easy nature than any land animal can obtain, or than the ingenuity of man can contrive; for, repose as it may, the land animal must always bear the whole of its weight on the one side; and, let the bed be ever so easy, and the position of the animal ever so well chosen, this is always a constrained position, and, if continued beyond a certain time, it is fatiguing. The sluggard, who loiters half the day in bed, actually lives a life of greater physical toil, and wears out the system of his body much sooner, than if he were up and doing betimes. From the equal pressure of the water in all directions, the fish, when it is motionless, reposes equally upon the whole surface of its body, under, lateral, and upper, and thus it suffers no inequality, and undergoes no fatigue. It is generally believed that some fishes, of the mackerel family and others, which inhabit near the surface, and are very energetic in their motions, during the season of their activity, at certain seasons of the year descend to a considerable depth, and hybernate there, or remain in a state of perfect inactivity and inexhaustion, with the mouth and eyes firmly closed—a particular membrane then extending over the latter. From what we know of the hybernation of other animals, whether the winter of their inactivity be the cold of the high latitudes, or the drought of the equatorial ones, (the account of which we must defer to our volume on WINTER,) it is by no means impossible, or even unlikely, that this should be the case with some fishes; and if so, a hybernation on the water would be the most easy of all hybernations; and a fish, in a state of perfect inaction, might remain there for a great length of time, without the loss of a single grain of its substance. Colonel Hamilton Smith mentions having seen a fish in this state, drawn up in the coil of a deep-sea line. This fish "was sound and firm, both eyes were nearly closed, from the nose back, caused by a white film of nictitating membrane, and the jaws were fixed close, so as to be opened with great difficulty." This occurred in the tropical Atlantic, about mid-way between Africa and America; but the time of the year, and the depth from which it was brought—both of which it would be very desirous to know—are not mentioned. So much for the perfect and easy repose of a fish in its abode in the water; and even if it reposes on the bottom, the pressure of the water makes it lie almost as lightly there as if the bottom were many fathoms below it, for there must be a pellicle of water under it, however thin.

But motion is comparatively as easy to a fish as rest is complete. Its relief, totally or nearly, from the burden of its own weight, is as advantageous to it in the one state as in the other. We have already hinted, that it can move with almost equal freedom in every direction; and it moves with very little resistance of friction, as well as with no resistance of pressure. There are certain pores, or follicles, on the body of a fish, that give out a mucous secretion, which lubricates its body, and prevents both the macerating action and the friction of the water, upon nearly the same principle as the working parts of a machine are rendered durable and free by oil, and the joints of a land animal by *synovia*. In the different races, this lubricating secretion is very exactly adapted to the necessity there is for it. If the fish inhabits near the surface, as in the herring and the mackerel, the supply of this is comparatively small; but if it inhabits deeply, as the cod, or drives rapidly about at various depths, as the different species of the skate, then the supply is more copious. Some of the apertures from which this lubricating secretion is discharged are placed far forward on the body,—generally on the snout,—so that the motion of the fish spreads it backwards: this prevents the fish from getting wetted, although it is constantly in the water; and this again prevents that tendency to come to the shore, which every wet thing that floats in the water has. We find a provision of this kind in every living production of the sea, as well as in the fishes properly so called,—in sea-weed and in the epidermis of shells and crusts; for, if these have motion in the water, or if the water has motion against them, they are always lubricated in such a manner that the friction and the wetting, which are in reality the same in principle, have but little effect upon them while alive. When they are dead the case is very different; for then they are taken hold of by the water and brought to the shore; and this is the reason why so many of the porcelain shells of the deep sea, not one of which is found in the living state, are brought by the currents to the tropical shores. It is the same cause which brings so much sea-weed, and sponge, and other substances that grow within the low-water line, to the beach, after the water has been agitated by storms. The remains of various productions of the tropical parts of the Atlantic are occasionally met with on the coasts of the Hebrides; but we are not aware that any of the same productions are ever brought there in the living state. There is thus a provision in the sea for keeping all its living inhabitants in those places which are best adapted for them.

The fishes have to contend more with the motions of the water than any of its other inhabitants; and for this reason they are so organized that they can contend with greater ease and effect. They are variously adapted in this way, because some have to contend with the swiftest currents, and the most turbulent water, and others are more habitually in the tranquil parts; but still, every fish is completely organized up to the full average of the state of the water with which it has to contend. Some which have merely to hold on upon the rocks, and wait for the food which the current brings them, are provided with suckers, by which they can attach themselves, and endure much violence of the water, with little or no expenditure of muscular effort. Others can hang apparently motionless in rapid currents, or even stem them; which is well exemplified in those species which ascend the rivers for the purpose of spawning,—the salmon in particular. They are most active in their ascent when the rivers are swollen by floods, and of course running with more than their average velocity; because then the fish can get over those shallows and rapids which they are unable to pass when the water is low. In so wide and so varied a territory as that of which the fishes are the most important inhabitants, it would, however, far exceed our limits to hint at all the varieties of adaptation that are to be found among them. The general principle is all that we can allude to; and even upon that there is not a more convincing proof of wisdom of design, and perfection of execution, in the whole of creation, than in the adaptation of the fish and the waters to each other, even to the minutest detail of its variations.

This brings us, very naturally, to the consideration of the general structure of a fish. It requires none of the supporting bones which are necessary for land animals; and as the exercise both of sensation and of muscular energy,—that is, of diversity in that energy,—which it needs, are comparatively limited, the skeleton and the nervous system are both much less developed than they are in the land animals; and the same may be said of all the working systems, except the alimentary and the reproductive.

With the exception of a comparatively limited number of races, fish still retain vestiges of all the parts of that type which we find in perhaps the greatest perfection in the mammalia. They have a head, a body, a tail, and four extremities, answering in situation to the same parts as in the mammalia; but with this difference in the majority of the races, that the tail is the grand organ of locomotion, and sculls them forward by striking alternately right and left, though it derives assistance from the breathing, and also from the scales, or the flexures of the posterior part of the body.

The bones of the head have more resemblance to those of birds and reptiles than to those of the mammalia; but there is, in general, very little motion of the neck. This is not required, as the animal can turn freely in the element in which it moves. The vertebral column, or backbone, is the most essential in the active or moving power of the skeleton; and, therefore, the great mass of the muscles is concentrated upon it. The different *vertebræ*, or pieces of which it is composed, and which are often very numerous, are not articulated, bone upon bone, as in land animals. The real joint consists in elastic cartilage, which unites the bones; and, in the backbone, this fills a hollow cavity in the end of each of the two pieces that are applied to each other. One division of the class have it altogether cartilaginous; and thus it is joint, or at events flexible, in its whole length. This back-bone has long processes, both on the upper and the under side, which give it the appearance of a double-toothed comb; only as far as the cavity of the body extends, the processes on the under side are divided into two, and the ribs are soldered to them by cartilage. The muscles, considered as organs of progressive motion, are applied to the sides of this combshaped spine. The fibres lie lengthways, in flakes, one answering to each vertebra, united by cartilaginous septa, which, like the other cartilaginous unions of the different parts of the body, are composed chiefly of gelatine; and thus they dissolve in cooking, and the flakes of muscle separate from each other and from the bones; and if the cooking of the fish is not carried so far as completely to dissolve those glutinous connexions, it is not properly done, so as to be wholesome as food. It is true that the people of all nations, in their very rude state, ate raw fish, and that in some parts of the world they do so still; for it is a very short time since a princess of the island of Taheite, who had been invited to dine on board of an English vessel, sent to the captain, beseeching a bottle of spirits to allay the stomachic disturbance which had been occasioned by a luncheon of raw fish, eaten absolutely under the stern of the vessel; but this is, of course, the exception, not the rule, in all cases where there is even a rational pretence to civilisation. These, however, though not quite irrelevant to our main subject, are not necessary portions of it.

This arrangement of the bones and the principal muscles of the fish, gives it a power in the caudal fin, or fin of the tail, greater than any thing that is to be met with in land animals; for, in them there is no such concentration, both of the bones and the muscles, upon any one single organ. Every single muscle, or flake, can act singly by itself, or the whole, or any number of them, can act together; so that it would require no small array of arithmetical figures to indicate the motions, and degrees and rates of motion, of which this most curious piece of animal mechanism is capable. They amount to many millions; and they are performed with a degree of ease unknown in land animals, burdened as these are with the load of their own weight, and subjected as they are to the decomposing action of the atmosphere, which consumes their substance by perspiration, either sensible or insensible, in the exact ratio of their exertions. It does not appear that fishes are subject to any waste in this way, other than the mucous secretion which lubricates their surface; and this is a working substance, and not a waste.

Fishes have another advantage, in the cartilaginous unitings of the vertebræ of their spinal column. These are, to a certain extent, universal joints, and capable not only of some flexure in all directions, but of twisting motions; so that, in the bony fishes, the tail is both oars and rudder. In the cartilaginous fishes again, the back bone is joint throughout the whole of its length, and admits of a variety of flexure and motion, altogether beyond the powers of arithmetic: in consequence of this, they are the most vigorous of the race, and some of them attain the largest size. The limit of the growth of all animals appears to consist in a certain degree of hardening of the bones; and when these have once become so indurated that they can increase no more in size, their decay may be said to have commenced; for it is a general law in the economy of living and growing nature, that no portion of a plant or an animal can remain in a quiescent state, except for a very limited period of time. It is easy to see the reason of this; and, though it is a simple matter, there is some instruction in it. Every organized being, animal or vegetable, is the result of an action of life, that is, of the power of elaboration in the germ, and of preservation and repair, to a certain extent, in the developed being. This is not produced by working in accordance with the general laws of inorganic matter, whether mechanical or chemical, but by working in opposition to them; and, during the whole existence of the animal or the plant, the principle of life in it is, so to speak, in a state of continual warfare with the principle of death; for the ultimate death of material being is nothing more than the return of its substance to a complete obedience to the laws of inorganic matter. Hence, if a part of the structure shall, from any cause whatever, suspend its living action, it is from that moment dead, and its remaining history is only that of a dissolution more or less rapid, according to circumstances. We have examples of this in hollow trees, especially those ancient yews which are found in many churchyards, where the surface of the trunk remains fresh, and puts out buds and branches both outside and in, for many years after the interior, which was "the tree" in the early stage of its duration, is dead and gone. In the animal kingdom we have no instance of a parallel case, that is, of the soft parts of the body retaining their vitality after the bones are gone, because there is no natural change of the flesh of animals into bones, as there is of the external and active part of the trunk of a tree into wood. But in the decrepitude of old age, when the spine becomes bent and the stature shrunken, there is an absorption of the matter of the bones; and in some diseases, the matter of bone is precipitated on the organs of circulation, and they become partially converted into bone; remarkable instances of which are to be seen in some cabinets of anatomy.

In proportion as the bones of a fish contain less earthy matter, and are more cartilaginous, the fish is exempted from this arrestment of growth, and beginning of decay; and thus we can assign no absolute limit to the size of the truly cartilaginous fishes, such as the shark and skate. Nature has, however, fixed a limit even for them, though we cannot find it; and though a skate is often a very large animal, the northern story of the skate that came to the entrance of the frith of Cromarty, to seek shelter from a violent storm in the North Sea, but which struck at once against both the "Shooters," or promontaries, that stand like pillars at the entrance, and which are some half-mile or three quarters asunder, and so was obliged to put to sea again, is intended as a sharp reproof to those who exaggerate the real wonders of the sea, till they become perfectly ludicrous. Without any absurd hyperbole, there is enough in the actual power of growth in these fishes, to excite our admiration and to exercise our philosophy.

Though the tail and the caudal fin, in which it terminates, form together the principal organ of motion in all fishes, yet they have not only in general four extremities answering to those of the other vertebrated animals, but they have, in most instances, other appendages to the body, which are peculiar to them as a class. These additional appendages are, one or more *dorsal* fins on the back, and an *anal* fin on the under part of the body, in the rear of the opening. These are not immediately connected with the spinal bones, but have their own bones imbedded in the substance of the flesh, and their own muscles; though the motion which they have is not generally very great. These fins, as also the fin on the tail, consist of a membrane stretched upon tapering supports which are called *rays;* which rays sometimes consist of entire spines of bone, and at other times they are composed of jointed pieces, and often branched toward their extremities. The spines sometimes stand alone without any membranes, and at other times they rise above these; and in either state they are frequently ragged, and capable of inflicting very painful, though not poisoned wounds.

Except some of the very lowest members of the class, which have hardly any definite skeleton at all, fishes have shoulder bones, bearing *pectorals*, or breast fins, which answer to the fore legs of land animals. The real fin may be compared to a sort of hand, the fingers of which are the rays, united by a membrane, something in the same way as the fingers of the fore paw are united in the whales, and the toes in the feet of ducks and other swimming birds. The whole of these members, except the hand, are hid under the skin; but there are a few fishes which have another length of bone free, and forming a sort of wrist, or peduncle, to the end of which the fin is attached. When this is the case, the fish can leap up from the bottom, and also crawl and leap about when the tide retires; and their gills, or breathing apparatus, are so formed, that they can live for a considerable time out of the water. Some of these fish swarm in the muddy bays on the north coast of New Holland, where they leap about like frogs when the tide retires. There is one, the Angler (*Lophius piscatorius*), not uncommon on many of the muddy parts of the British shores. It is about the ugliest of our fishes, and as ravenous as it is ugly. But there is something curious both in its structure and its economy. Its head is very large, flat, and round, and the opening of its mouth immense, with beards or fleshy filaments round the margin of the lower jaw; the pectoral fins stand out upon peduncles, and have some resemblance to the tails of ordinary fish; and the body is slender, and evidently incapable of moving the monstrous head with any degree of swiftness through the water. The eyes are in the top of the head, looking upwards, near to each other, but separated by two toothed ridges with a groove between. It is thus admirably organized for suddenly starting up and seizing any fish that may be swimming over it. It can swallow fishes of considerable size, as it is sometimes five feet long; in which cases the gape of the mouth is about a foot in diameter. The fishermen often find live flounders and other fish in its stomach, of which they make prize. Its mouth is a very perfect swallowing one, having numerous crooked teeth on the jaws, the bones of the palate, and the tongue. When it is held with the mouth open and upwards, one can see into its stomach, as into a bag.

The most curious part of its structure, however, is what is regarded as being the angling apparatus. This consists of three spines on the central line of the top of the head, one near the nape, and two near the extremity of the upper jaw. They are long, equal to about one fourth the whole length of the fish; they are flexible at their extremity, and the one next the mouth bears a little glittering silvery flag with two tails. These appendages consist of slender tapering bones, covered with a very sentient membrane; and they are, especially the one which carries the flag, flexible toward the points. Their bones are articulated on the bones of the head, in a manner of which there is hardly another instance among fish; and there is no joint like the first one in the whole animal kingdom. The base of it is formed into an eye, which works in a staple of the bone of the head, thus admitting of motion in every direction, and incapable of being torn off, except by actual fracture of the eye or the staple, both of which are very tough and strong. The muscles which put it in motion are close to the base, so that the shining flag can be moved about with wonderful celerity. The bases of the others embrace the ridge of the bones of the head, like stirrups; so that they have rapid motion, backwards and forwards, but not in any other direction. The flag, which resembles in colour many of the little fishes, the launces, for instance, upon which larger fishes feed, is understood to be the bait; the spine to which it is attached is the rod and line; and the mouth is ready, as a more efficient engine of capture than the most skilfully constructed hook of the human angler. It is also said that this fish acts upon the adage, "best fishing in troubled waters," for it keeps stirring the mud, so that, while the bait is seen, the angler is concealed. Its colour contributes to the concealment, being of a dull brown, loose, wrinkled, and without scales. Those who bring the doctrine of an immortal spirit in man into jeopardy, by attributing purpose, and "an inferior kind of reason," to animals, expatiate eloquently on the "art" practised by this fish; but truly there is as much art in the coming of a rosebud in the summer, or the fall of the snow in the winter, as in any action of any animal. The art is from a far higher source, and both art and apparatus are transmitted from generation to generation, though the rudimental egg is cast upon the waters, and abandoned by the parent. Still, the angler is a most singular creature, the sight of which would alone amply repay a visit to the shore;—and there are hundreds of others there, all equally interesting, if our limits would admit of their enumeration.

Other fishes have the pectoral fins very long, and in the form of wings. They are usually seen out at sea, in the warm latitudes, where they leap from the water, like flocks of birds rising, only they leap in all directions. Their leap is pretty high, for they often fall on the decks of ships; but they have not the least power of motion, or even command of themselves, in the air; and thus, though popularly called "flying" fishes, they cannot fly: their long fins only enable them to take one leap out of the water, and protract their fall back again. The name *Exocetus*, which naturalists give to these fishes, means that they are "out of their place;" and was applied by the Greeks to a fish which they supposed leaped ashore to sleep. Their leaping is an attempt to escape from their enemies, which are generally large fishes of most brilliant colours; and the exhibition is altogether a splendid summer sight; but it is to be seen on the expanse of the warm seas only. A solitary specimen is, indeed, sometimes seen in the south of England; but too rarely for a casual visitor to expect it.

The tails of fishes are often weapons as well as organs of motion. Some, as the lancet fishes, have blades of hard bone on the sides of them, with which they can inflict severe wounds; others, as the fox shark, can strike most formidable blows, so that one of them striking in the middle of a flock of dolphins, makes them scamper off in all directions, as antelopes do when the lion springs among the herd; and others again, such as the skate, which have the tail rounded and flexible every way, lay about them in all directions, as if armed with a flail. Indeed it is often more formidable than a flail, as the spines upon it wound and tear, like the *morgensteirn*, or spiked ball, at the end of a chain and pole, which was used by the Saxons in their wars, and of which an imitation may be seen appended to one of the ridiculous figures in the Guildhall of London.

Large spines upon any part of a fish, are always suspicious instruments when the fish is alive. They are always there for defence: and while the energy of the fish remains, it will strike with the spine most unerringly at whatever touches it, wherever the spine may be situated. None of their spines are poisonous; but they are often toothed, inflicting wounds which are difficult to heal, and sometimes producing locked jaw,—as certainly fatal as the most virulent poison. If the visitor of the beach meets with one of these armed fishes stranded alive, he must therefore be careful how he touches it.

The appendages to a fish, which correspond to the hind legs of land animals, form what are called *ventral*, or belly, or rather "under-side" fins. Their bones in no case form a pelvis, or have any connexion with the back bone; and they are sometimes situated more or less backward on the body, and have their own imbedment of bones in the flesh; and sometimes they are attached to the shoulder bones, the same as the pectorals, and a little in the rear of these, immediately under them, or in advance, according to the habits of the species to which they belong. The blade bone, or first bone of the shoulder, is also applied to different parts in different fishes. In some it is imbedded in the flesh, as it is in mammalia and birds; in others it is united to the bones of the spine; and in others, again, it is united to the bones of the head. In some, the ventral fins are entirely wanting, and a few also want the pectorals; and these are all eel or serpent-shaped, swimming by the flexures of the body, rather than by the alternate strokes of the caudal fin. They are bottom fishes, often lurking in the mud and sludge; and most of them are very tenacious of life, and can live for a considerable time out of the water, while not a few of them can crawl and climb.

The distribution of the body fins is essential to be attended to, by every one who wishes to look with understanding upon the characteristic inhabitants of the deep, whether in their summer display, or in their general economy. If all the fins are distinct and perfect, and the ventrals are *abdominal*, that is, have their own separate imbedment into the flesh of the body, then the fish is a straightforward swimmer: a mackerel or a herring is an instance of this. If, on the other hand, the fins are concentrated on the head, the position of the fish is at or near the bottom; and it preys above or below its own level, according to circumstances, which are indicated by the way in which the mouth opens. If the fish lurks at the bottom, in wait for food above it, then the lower jaw is longer than the upper one, or the mouth opens slantingly upwards; and if it catches the food on its own level, or below it, with the head inclining downwards, the mouth opens in the usual way. The Weevers (*Trachinus*), of which there are two species, the greater and the less, on various parts of the British shores, but more especially those of the Channel, may be mentioned as instances of the upward mouth. The large one inhabits deep water, and is less frequently seen than the small, which lurks in the mud for its prey, and is very tenacious of life. Both have very dangerous spines in the first dorsal fin, especially the small one, which is not above half a foot long, and yet it inflicts wounds of so ragged a character that the pain extends over great part of the body. These two species of the same genus show the different effect of the season in fish that inhabit different depths of water. The small one, which is in the shallows, deposits its spawn in spring: the large one, from the deep water, does not till the summer; and most of the deep-water fishes which inhabit near the bottom, obey the same law.

The shape of the body in fishes affords a tolerable guide as to whether they are fishes of the free waters or of the bottom. If they are inhabitants near the surface, and not much given to ranging about, the body is compressed, and short as well as thin in proportion to its depth. Some of them have the body much deeper than the length of both body and tail, with the dorsal and anal fins extending far backwards beyond the fish, and the ventrals in front of the pectorals, and also very long. They are confined to the warmer seas, mostly to those within the tropics, where the surface of the sea abounds much more in food than the seas of high, or more temperate latitudes. They are tropical in their colours, as well as in their abode; for the greater number of them are exceedingly brilliant; and on this account they are much sought after by collectors of natural curiosities. Their colours in a cabinet are nothing to what they are in a state of nature; for there is no brilliance that fades sooner than that of a fish. There is, indeed, a summer bloom upon almost all fishes, wherever they inhabit, and at whatever time of the year their Summer, which is that during which they mature their spawn, may be. So completely does the rich metallic lustre which salmon have when they come from the sea, wear off when they have spawned, that they are then called black fish. The surface fishes, of which we have been speaking, are chiefly found near the shores, on the great masses of sea-weed which remain in the eddies of the tropical currents; and they feed partly on the more succulent kinds of the weed, and partly on the small animals by which it is inhabited. Some of them have the habit of shooting flies with drops of water squirted from the mouth, and they rarely miss their aim, even when the fly is at some distance from the water.

Fishes which range freely and to long distances, have the body long, and but little compressed; and in them the caudal fin is more finely developed than in any others. The mackerel, which is the typical fish of a very numerous family, is the most characteristic one which is abundant on the British shores; and with us it is a Summer fish, appearing earlier or later, according as the season is more or less warm, and spawning in the latter time of the year, so that the young are ready to furnish a supply of food for those races which appear on the coast later in the season.

Mackerel, pilchards, and herrings, are the three races of fish that come to the shores of Britain in the greatest numbers; and they have their Summer at different times of the season. The pilchard comes first, and in vast shoals, but it is local. Next to it comes the mackerel, a fish of a different division of the class; and, as it is a more vigorous swimmer, it probably comes from a greater distance. Lastly comes the herring, which belongs to the same genus with the pilchard, and has the same habits; but it is a more northerly fish, and winters in rather colder water, though certainly not in the polar seas, as the old describers alleged.

It must not, however, be understood that these three kinds of fish divide the time with each other, so that the one is gone before the other comes; for the times of their appearance run into each other, and they all remain for a time on the shores. Twenty-five millions of pilchards have been taken to one port in a single day, and these would hardly leave a blank in the total number; even upon that part of the coast herrings are still more numerous, but they are more ranging and more widely distributed over the coasts; so that so many are seldom taken at one place. When, however, the shoal is stranded by a storm, the millions that strew the beach are absolutely incredible to those who have not actually seen them. One who has witnessed the beach for two or three miles covered to an average breadth of ten feet, and a depth of two or three, can form some idea of the stores which are provided in the mighty waters. Mackerel are not so very abundant; but there have been instances of a million and a half taken at Yarmouth and its vicinity, in a single season.

Whatever may be the time of their appearance on the coast, it is always to be considered as the Summer of these fish, which are thus a Summer product of the sea. They shoal when they are in the full bloom of their beauty, and in the prime of their condition. It is the stimulus of a certain progress of the spawn which brings them from the deep water; and while they are congregated in shoals, the spawn is in progress to maturity; but they do not go in mass for the depositing of it—they proceed in single pairs, and range along for a considerable time, before the operation has been performed by the whole; and some stragglers come much earlier, and linger much later than the great bulk of the shoals.

During this, the Summer visit of these fish, they appear to have far more energy of life, and are much more voracious in their feeding, than when in the deep water. When in the deep water, both the herring and the pilchard are said to feed upon small crustacea; but when they approach the shores, they are miscellaneous in their feeding, eating readily the young of their own species, which have not wholly quitted the shore when the old ones make their appearance.

Of the smaller members of the herring family, some have their Summer in the warm season, and some in the cold. The chief British summer ones are the white bait and the shad. They enter the estuaries of some of the rivers early in the season, but the white bait about a month before the shad. White bait does not appear to remove far from the mouths of the rivers in the cold season; which may be one cause why it is so local, though it may exist in rivers where it has not hitherto been found; for all our estuaries have not been fished with the same assiduity as the Thames, which, and the Hamble near Southampton, are our principal, or our only white-bait rivers. It comes to the top of the brackish water, to mature and deposit its spawn, as that has a higher temperature than either the salt water or the fresh. The operation continues nearly the whole of the hot season; and the fish has been taken near the mouth of the Thames in the winter. The shad is also a Summer fish, but it is more hardy and rambling; and although not very abundant, it is found a considerable way up the fresh water.

The sprat comes in winter, as an estuary fish; and often in such numbers, that sprats are sold to the Kent farmers for manure, at the rate of sixpence a bushel. Thus, when we say that the produce of the sea is far more abundant than that of the most fertile portion of the land, we state only the simple fact. Ten thousand, applied to the support of the rest of nature, for every individual left for the continuation of the race, would, upon the average of all the varieties of fish, be quite enough to keep up the abundance of the sea, and even to increase its stores.

The "white fish," as they are called, on account of the colour of their flesh, alternate with the races which have been mentioned, in the time of their production, and of course of their coming to the shores, or to those places where man may most easily capture his share. Of these there are many, although they are neither so numerous nor so varied as the former; but there are two families which, as tenants of the sea, are peculiarly characteristic, and peculiarly valuable to man: these are the cod family and the flat fish; and, in Britain, they may be considered as the staple productions of the sea, as those which are found at the greatest number of points on the coast, and throughout the greatest portion of the year.

The two families of white fish which we have named, are inhabitants of the temperate, and especially of the colder latitudes; and they, the cod family especially, are found in plenty on the coasts of those northern countries, where the land yields but a scanty and precarious return for the most industrious and skilful culture. The productiveness of some of them is great, not only beyond that of any vertebrated animals which inhabit the land, but beyond that of the fishes, which are more discursive, and inhabit nearer to the surface of the water. If the fact had not been ascertained by men whose accuracy and integrity are both above all question, it would not readily be believed that the roe of a single cod fish has been found to contain *nine millions* of fully matured eggs; and although the whole of the cod family are not so abundant in their production as this, and neither are the flat fish, yet the fertility of the whole is very great: and if there were not means by which the surplus could be consumed, these two families would, of themselves, in a very few years, render the waters of the ocean, ample as is their volume, actually solid with fish.

Neither of these families is so ranging at the time of spawning as the surface fishes; for, though they do shift their ground, both for the maturing and the depositing of the eggs, they do it only for a little way, and it occupies a comparatively brief period of time. From their comparatively stationary habits, they are not so much exhausted as the ranging fish; and thus they continue in good condition for human food to a much nearer time to that of the depositing of the spawn; and they also recover their flesh much sooner after that operation. Hence they are in good condition during a much longer period of the year; and it is not only possible, but highly probable, that, with some little shifting of the fishing ground with the season, very many of them might be obtained in a wholesome condition all the year round.

There is one circumstance worthy of attention, as showing that these fishes,—the cod family especially,—belong more to the cold seas than to the warm; and that is, that they are more numerous and longer in good condition on the coasts of the northern parts of the British islands than on those of the southern. In the month of December is the best month, in which they are regarded as being in the very best state; but in the north they are good till January is wholly or nearly elapsed; and they are again in excellent condition in the early part or toward the middle of May. It does indeed require some knowledge of the ground, on the part of the fishermen, to find them in the last and the first parts of the season; but this knowledge well pays the very little trouble that it costs; and there seems to be little doubt, that if it were prosecuted with a little more science and perseverance, the period between the close of the one fishing season and the beginning of the next, might be very much obliterated, if not altogether got rid of.

The reason that gives so much probability to this constant productiveness of the white fishery, is drawn from the analogy of the sole. The sole is one of the most southerly of the British white fish; and, though it is found on the northern coasts, and even on those of the northern isles, it is not in great plenty there, and it is of much smaller size than in the south. None of the flat fish are well adapted for rapid swimming, or long migrations from place to place; and perhaps the sole is less qualified in this way than any of the rest. It is also very exclusively a ground feeder, and can hardly be taken with bait of any kind; so that, when it is not so abundant, and the market so good and so certain as to admit of the expense of the trawl-net, it is seldom fished for. Accordingly, it is not a staple fish in any of the more northerly parts; and, although the fishing has been tried in the offing of the frith of Forth, we believe it has never paid the expense,—at all events, it has been abandoned. In the south, again, this fish is caught in great numbers, and it is in good condition for a longer time of the year than any other species; and, by shifting into deep water during the time when the fish on the shallower banks are in bad condition, it may be found with no interruption, and only a little more labour, all the year round. In the south, the spawning time, when the fish is soft and not wholesome, is about the month of February; and the period during which it is unwholesome or disappears, varies with the depth at which it inhabits. It is a bank fish every where; and it is found from the banks in the deep estuaries, to those that are a considerable distance to seaward. For instance, it is found in the river Arun, in the south of Sussex, at the distance of five miles from the open sea, though the Arun is but a small river. This comparatively inland situation, is, however, not quite so congenial to the fish as places more to seaward, and less affected by seasonal causes; for in that river, the fishing does not begin till May, nor continue beyond November; and the accounts state that, during the cold months, the fish remain at the bottom, in a state of partial or complete inanimation. In the sea it is very different; for there the fishing may be continued till the end of January, and begun again in March; or, as we have hinted, it may be continued by shifting the ground.

The flat fish feed chiefly upon small ground animals; and the foragers, which regulate their numbers, are in an especial manner the rays or skate, and the ground sharks, which, of course, are more ranging than their prey, and swim higher in the water; and they have the mouth under the snout, by means of which they are better able to capture their prey. The cod family are much more of swimmers, and do not remain so closely at the bottom, though they also are to be regarded as bank or reach fishes, and not as surface ones. They are all very voracious and indiscriminate in their feeding; and they do not scruple to eat the smaller ones of their own species; so that the vast productiveness which has been noticed, tends, in some degree at least, to the support of the fishes themselves. It also appears, however, that the countless multitudes of the fry of the cod family serve, in great part, as food for the more migrant fishes, when these quit the shores, and resort to the deep water, to recruit their strength after spawning. Thus, upon what race soever of its living inhabitants we take up the study of the Summer action in the sea, we find that in every case its productiveness, and the capability of the surplus production to supply the whole with food, is equally wonderful.

There is still one little point connected with this part of the subject, which we cannot pass wholly unnoticed, because it shows that a most beneficent part of the law of nature extends to the productions of the sea as well as to those of the land. After an animal is developed, it must run its progress without pause, unless in those cases where its nature is to hybernate; and even where this is the case, it is doubtful whether it tends to prolong the whole life of the animal; for instance, it is doubtful whether a marmot on the mountains, which spends the winter in a state of repose, lives longer than a hare on the plains, which undergoes no hybernation. But be that as it may, those animals which are viviparous have not, from the time that the rudimental germ is first stimulated into life, to the period of their dissolution, any one state in which the action of life can be said to be completely at rest, and which might by any artificial treatment be protracted. They may be asleep during the night, in which state the greater number of their functions go on without any interruption; and they may hybernate, in which state the greater part of their functions are suspended; but even the last of these, in its most complete state, cannot be regarded as a period which can be protracted indefinitely; for the progress of the animal, from the beginning of its life to the end, is continuous, and admits of no absolute suspension or pause.

With oviparous animals the case is different, for the egg may, like the seed of a plant, be kept for some time in a state of perfect inaction, without impairing its vitality. How long this may be done has not been subjected to very decided experiment; but that it can be done is proved, both by the analogy and the fact. In the case of vegetable seeds, the length of the pause does not appear to have any absolute limit, in the case of some species, as is proved by mould from great depths being speedily covered with vegetation, under circumstances which precluded the possibility of any fresh seeds reaching it. It is also highly probable that the eggs of many insects, which are unhurt by great extremes both of heat and of cold, may remain for an indefinite length of time, and yet quicken into life, if placed under circumstances favourable to their vegetation.

The eggs, or spawn of fishes, appear to possess this property to a very considerable extent. We have heard of the spawn of salmon becoming quickened after having been for a considerable time buried in mud heaps: but as this has generally been alleged of the roe, as taken from the female fish, when too far advanced for that fish being wholesome as food, and without any reference to the fertilizing of the eggs, it does not appear to be worthy of any credit. It is true that the roe taken from the body of the female salmon cannot *lose* its vitality, for this simple reason—that it has no vitality to lose. We do not, however, happen to know how long the roe will retain its capability of being vitalized, after it has been discharged from the body of the fish; for this, though a subject of no inconsiderable interest in the economical treatment of fish, is one upon which we are not aware that any experiment has been made. But it is pretty well ascertained, that in many of the warm countries, where there are seasonal pools during the rains, which vanish in the drought, there are also seasonal fishes, of which, as is the case with the purely Summer insects of this country, the whole developed race perish as the water dries up, and leave the succeeding generation in the roe, under the care of nature, until the rain shall again return, and the germs be stimulated into life, and developed, and perform their functions—till they shall have committed their successors to the keeping of nature, and they themselves are, like their ancestors, gathered to the dust. Some races, no doubt, bury themselves in the mud at the bottom of the pools, when the water becomes too hot for them; but as no vertebrated animal can bear absolute drying, which annually takes place in those countries to a far greater depth than any fish can descend into the mud, there must be another means of preserving the races during the extreme ardour of the tropical Summer; and the only way in which we can suppose this to be done, is by the preservation of the egg, before the stimuli have awakened the principle of life in it. How speedily those eggs may be developed, after the rain and humidity come, is a point which has not been ascertained, though we have reason to believe that it takes place much faster than in the waters of our country, even under the most favourable circumstances of situation and season. Now, if the roe of a fish, or any other germ of an animal, which has been fertilized, but not quickened, can, by being placed under peculiar circumstances, be preserved beyond the time at which it usually comes to life, the period during which it can be so preserved, is not definitely fixed to a stated number of days, any more than the time of its remaining inert under ordinary circumstances. It is well known, that the salmon fry do not make their appearance so early when the season is cold and backward, as when it is warm and genial. This shows that time is not a necessary element in the quickening of them; and this being once established, we have only to continue the circumstances which preserve their vitality, and at the same time prevent their development, in order to have them preserved for a period of indefinite length, and yet ready to awaken into action whenever the proper stimuli come to be applied. Thus, along with the astonishingly great productive power of life, in the characteristic inhabitants of the water, there appears to be an equally wonderful power of conservation; and we cannot tell how many races of aquatic beings may be slumbering in their germs, in those abysses of the ocean which no influence of the atmosphere or the sun can reach, but which may quicken into activity, if any revolution of the globe shall upheave the places of their present repose, till they are within the sphere of the requisite stimuli. This is a subject upon which it behoves us to speak with the greatest caution. We know what we mean by the death or the dissolution of an individual animal; and we also know that when the signet of death has once been set upon it, there is, in the course of ordinary nature, no future return of that animal to the gates of life. We know this—we know when the living action of the body has ceased, and the substantive matter of which it is composed is given up to the common laws of inorganic matter. But to know this, and to know the death of *animal life*, or even vegetable life, are very different matters. This is a dark page of the book of nature, and it is beset with dangers; so that if we are not very careful, a mist will come and obscure the light which points our own faith and hope to the regions of immortality. Life, be it in animal or plant, is not organization, or the result of organization. The animal or the plant is not first made perfect in all its parts, and then put into living action, in the same way as we construct a machine, and then set it agoing. The organization is the product of the life; and, therefore, we need not say that the life must have the priority in existence. But life, like light or heat, is action, not substantive matter, not in any way to be estimated by weight or measure, and not cognizable by any of our senses, unless it has some organization which itself has elaborated, through the medium of which it can reveal itself. But it does not thence follow that life has no existence; for, on the contrary, without it there could have been no organized being, any more than there can, in any other case, be produce without any producer.

The inference from this is as plain and as obvious as any inference can be, and it leads us directly to the account given in the sacred volume; namely, that not only life, taken in general terms, was part of the work of the Creator at the beginning, but that the wonders of his power reached and determined every kind of life; and that, without a new creation—an immediate exertion of the power of the Almighty—there cannot be a single new animal or new plant added to the kingdoms of living and of growing nature.

This is a matter of which we ought never to lose sight, in any one of our researches concerning the works of nature; for if we take only the one result of creative power, the mere material substance which is palpable to the senses, and leave out of our consideration the other and more wonderful, though mysterious one, of action, we have only half of our subject before us, and that far from the most important half. When the body of an animal is scattered to all the winds of heaven—dissipated through the air and the waters, and over the earth, until not an atom of it can be identified or even known, we never suppose that there is one atom of it lost, or for one instant, amid all its changes, hidden from the eye of Omniscience; and we may be well assured that, if it were the pleasure of the will of Him who made and who directed it, to say "Return," it would return, and retraee all the steps of its progress, even though these were longer in their duration than the world has hitherto lasted, and more numerous than all the grains of sand upon all the shores of the sea. Among the various subjects which this view of creation, on the origin both of matter and of every kind of action which matter displays, brings to our consideration, the resurrection of the body, after whatever number of changes the matter of that body may undergo, is by no means the least important, or the least pleasurable to our feelings; but it is one into the particulars of which we cannot enter, for reasons which must be obvious to every reader.

There is still another point connected with the natural history of the fishes, some knowledge of which is necessary before we can look upon the sea, even in its Summer economy, with an eye of right understanding; and that is the grand structural characters of the fishes, by means of which they are adapted to the several purposes which they serve, in the grand system of nature. We allude not so much to the external form, or the specific depth of water which one or another of the fishes may inhabit, as to the foundation, so to speak, or their organization, and to their whole structure, as resting upon this foundation. The foundation to which we allude is the bones of the skeleton; for this may, in every vertebrated animal,—and they are the only ones that have internal bones,—be considered as determining the character of the whole organization; which again leads us to the style of their motion, their general habits, and all that can be known about them without detailed examination of the individuals.

The first and most obvious division of the fishes, according to the nature of the skeleton, and the general structure and habits as depending upon that skeleton, is into two sub-classes,—bony fishes, or those that have a considerable degree of stiffness in their skeletons, although in this respect they are not equal to the mammalia or the birds, or even to the reptiles; and cartilaginous fishes, or those which have all the bones flexible, composed chiefly of animal matter, and with little or no earthy salts in their composition. The last are technically called *Chondropterygii*, which literally means that they have all the rays of the fins cartilaginous; but the character extends to the whole of their bones, although their teeth, and the tubercles, spines, or plates, on their external surfaces, are often more hard and compact than almost any bone. These Chondropterygii are few in number as compared with the bony fishes, but they are, generally speaking, animals of great power, and remarkably tenacious of life; and most of them are exempted from the most severe labours to which the bony races, which are considered as the true fishes, are subjected.

Each of them admits of a further subdivision, before we descend to any of the details from which these inhabitants of the deep are arranged into families, and even into orders,—to say nothing of the minor arrangements of genera and species.

The bony fishes, or true fishes, are subdivided into those which have some of the rays of the fins composed of single spines, or needle-shaped bones, without any joint in the course of their length; and those that have the fin-rays jointed, or the fin itself altogether soft. The first of these are called *Acanthopterygii*, which merely means that they have spines without any joint in one or more of their fins; and the second are called *Malacopterygii*, which means that they have the fins soft. The spinous-finned ones are by far the most numerous in species, and they are considered as the most typical of all the fish, and placed foremost in the systematic arrangements; but it is doubtful whether, as taken upon the whole, the soft-finned ones are not the most valuable to man, though many of the spinous ones are highly palatable, and light and easy of digestion.

The spinous fishes are, in an especial manner, the Summer ones; and they are much more abundant in the warm latitudes than in the cold. In the former they literally swarm, some in the fresh waters, some on the shores and among the rocks and sea-weed, and some again range freely the expanse of the ocean. Very many of the tropical ones are remarkable for the singularity of their shapes, and equally so for the beauty of their colours, which rival those of the birds and the blossoms of these sunny lands, and display the influence of the solar ardour far and wide over the sea. On the south coast of England, there are some that appear regularly. The striped red mullet, for instance, is not rare, and in excellent condition in May and June; but is occasionally caught all the year round. The gurnards spawn about the time that the mullet is in perfection, and are in their best season about October. The goby family (*Gobioidæ*) are among the most abundant of the spinous fishes on the British coast, and they are found on most parts of it. They are not in much esteem as food; but they are of singular, and some of them of repulsive appearance. Among these may be mentioned the sea wolf or cat fish, the head of which has a slight resemblance to that of the cat; and the mouth is furnished with most formidable teeth, the front ones long, strong, and curving inward, like the canine teeth of a beast of prey, and the others with the crowns rounded. It is a long and strongly made fish, with the body glutinous, the dorsal fin extending nearly the whole length of the back, and the anal along the posterior half of the under part, no ventral fins, and the pectorals capable of being slightly turned up, so as to resemble ears. It scrambles among the rocks, feeding chiefly upon shelled mollusca and crustacea; and such is the power of its teeth, that it can crack whilks and periwinkles with the same ease that a monkey cracks nuts. When taken it is a very formidable fish; it bites terribly, and resembles the cat, in its tenacity of life. Its flesh is not bad, but its appearance is against it, and therefore it is seldom eaten. It comes nearer to the shore to spawn in the warmest months, at which time it may be seen on almost any part of the coast near where there are rocks.

The list of even British fishes with spinous fins is, however, much too long for our enumeration. They all spawn in the late spring or early Summer; and, as the eggs are soon hatched, the fry are in abundance as a store against the autumn; so that they both supply food for each other, and for those fishes which come to the shore in the autumn; as the fry of these, again, support the spring visitants. Thus a continual demand exists, and it is never without an adequate supply.

The soft-finned fishes, though there are many surface ones among them, generally inhabit deeper in the water than those with spines. Their bodies are in general softer, their bones smaller and rather more numerous, and the fibres of their muscles shorter. Thus, though they have not the same vigour in driving forward through the water, they are more lithe in their motions.

In genera and species, the soft-finned fishes are not nearly so numerous as the spinous ones; but some of them are the most productive of all fishes. Their grand habitat is polar, though they and the former ones mingle in the middle latitudes; and, where they meet, may be regarded as the situation in which the sea is most valuable to man. They spawn in the colder months of the year; that is, some time from the autumn to the spring inclusively, according to the species and the season. They all approach the shores, or come to the more elevated parts of the banks, to mature as well as to deposit their spawn. The maturing of so much as they deposit occupies a considerable period of time; and, during the greater part of this, they are in excellent condition, and, as they are eager for food, they are easily caught by hook and line. Some ascend the rivers, as for instance the salmon; but these do not go far up the current, until the snow-water has run off and the warmth of the season begins to be felt. In all cases they are fond of lingering in the brackish water, on account, no doubt, of its higher temperature; and such as are caught there, are of superior quality to those caught any where else.

The times when those fishes come to the shores and the banks, are times of plenty there, not only in the invertebrated animals, which are especially abundant in those places, but also in the young of other fishes, which are then on their progress seaward. Not only this, but the time of "banking" is usually so protracted, as that they are partly fed upon the young of their own species. A cod never tastes the worse for having been a bit of a cannibal in its fattening. As "cannibal" is a word, at the mere mention of which most people are apt to revolt, we may just pause one moment, to mention that some of our own species are virtually cannibals, in a way which they are but little aware of. The discontented and the habitually avaricious have, as the poet says, "a lean and hungry look;" and the reason is, that the canker of their own dispositions is constantly eating the flesh off their bones.

This grand division of the bony fishes admits of a more clear arrangement from the position of the ventral fins, or their absence, than the spinous grand division. The salmon family, the cod family, and the eels, may be taken as expressive. The first of these, that range freely through the waters, and feed at the surface, the bottom, or in the mid-water between, according as food may present itself; the second of these, which are bottom feeders only; and the third of these, which are mud-fishes, properly so called, and often have holes for their dwellings in the soft bottoms and banks of the pools. Examples of all the three may be seen in the same river, in the common trout, the burbot, and the eel. The trout spawns in the autumn, and thus it is in condition during half of the spring and autumn, and the whole of Summer. It ranges boldly about; and the clearer the water is, and the more it abounds in pools and rapids, the trout thrives the better, and is the finer in appearance and flavour. The burbot is not so generally found in the rivers of Britain, as the trout. In appearance and habits it partially resembles the eel, and, like that, it is very tenacious of life, and may be kept a considerable time out of the water. It spawns in the spring; but is in condition all the Summer and autumn, and part of the winter. The burbot has the ventral fins very small, and placed considerably in advance of the pectorals.

The fish which it most nearly resembles in form is the ling, which is a rock fish of the high latitudes, and one of the most valuable of the cod family, especially for dry curing. The flesh of the burbot is excellent; and, as the fish is remarkably hardy, there is none more worthy the attention of those who promote the improvement of fresh water fishes. The eels inhabit still lower than the burbot, and their tenacity of life, and the litheness of their motions, are quite proverbial. They are very impatient of cold, and bury themselves in the mud, or descend to warmer places when practicable, during the winter. If they are suddenly overtaken by severe frosts, in shallow places, where they cannot bury themselves, they are killed in great numbers; but their extreme susceptibility of cold is also their warning to make from its effects. They spawn in the warm season, earlier or later in the Summer, according to circumstances; and towards autumn they descend the rivers, ascending again in the spring.

The cartilaginous fishes are few in number, as compared with those that have bones; but some of them are among the most powerful of all fishes, ranging the seas from pole to pole. Some of them, as the sturgeon, and also a few fishes of singular form that are found in the sea, have the gills, or breathing apparatus, partially resembling that of the fishes properly so called, and they also resemble these, in part at least, in their other characters and their economy. The rest, which are the characteristic ones, have the gills in the form of partitions, fixed at both extremities; some of them bring forth their young alive, and those which have not this habit, produce perfect eggs, in horny cases, which can often be gathered on the beaches. By this means, the fishes are exempted from those seasonal resorts to the warm part of the water, which are necessary in the case of the bony fishes; and thus they, at all times, have free range of the deep; and such as are used for human food are in good condition at almost any time of the year when they can be found. When they approach the shores, it is generally for the purpose of feeding upon the fishes that come to the shore for seasonal purposes, and not for any physiological purpose of their own; though such of them as deposit eggs, resort nearer to the shallows, or the beds of sea-weed, in order that the eggs, which are generally of an oblong shape, like little pillows, with claspers or tendrils at the corners, may be attached to other substances, until the young fishes come to maturity; at which time they burst the horny case of the egg, at the end toward which the head is situated, and come into the waters, but still with a little portion of the egg attached to them for their temporary subsistence; and the horny case loosens its hold on the sea-weed or the stones, and is washed to the shore as a cast off and unprofitable thing.

The Summer economy, that is, the economy of the production of life in the sea, is a subject which can hardly be exhausted, even in the comparatively limited portion of it which has been so far observed as to be matter of knowledge; and then, that is so mere a fraction of the whole, that any one who visits the sea, with the requisite preparation and desire of knowledge, may rest assured that his labour will not be in vain. It is there that the power and the goodness of the Creator are displayed upon the most magnificent scale. The sea, which divides rude men from each other, brings civilized men much nearer; and while to the uninformed eye it appears to be the waste of nature, it is, of all portions of our globe, the most productive.

CHAPTER VII.

SUMMER TO LAND ANIMALS.

LIVING creatures, considered in the average of their varied classes and tribes, are much less under the influence of the seasons than vegetables; and they are so, because the law of life is to them a far more powerful law than it is to the others; and, by being more under its dominion, they are necessarily less under the dominion of the common laws of matter. The Summer preparation, and the Summer purpose are, however, the same in principle, to the members of the one of those kingdoms of nature, as they are to the members of the other kingdom. The purpose is to link year with year, and age with age, so that, while the individuals are continually perishing, and yielding up their substance to the general store of matter, or the maintenance of the rest, the race may be continued, and its numbers may increase or diminish, according as the proper balance of all the parts of the system may require. Thus, though there is a "number of days" beyond which no individual can exist, the whole remains as new, as fresh, and as young, as when the fiat of the Almighty called it forth out of nothing.

This is the wonder of the working of creation—that which the man who thinks, dares not but admire, but of which even the slightest degree of imitation, the skill and the dexterity of all the men that ever lived, cannot attempt. This places in a striking light the inconsideration of those who go about to prove the existence, and do honour to the majesty of the Creator, by comparing his works and their workings, with the works and the workings of human beings. They are not the same in kind, and thus no comparison can be instituted. Man requires materials, and tools, and the instruction of experience; and then the use of every thing that he fabricates, is the wearing and decay of it, without the slightest tendency to renovation or replacement. The word, the will of the Almighty, is the materials, the tools, the thing produced, its renovation and repair, and its continuation for ever. We say "*for ever*," because we would call attention to the expression. As applied to material nature, these words do not mean duration that shall never, and can never, have an end; they merely declare, that that to which they are applied involves in itself no element of its own destruction—that it is continually *of the spring*—new every moment, and, therefore, never of itself nearer to, or having the least tendency to approach, its end. In this sense,—the only one in which it can apply to material nature,—the tendency, the principle, the energy of the continuation of every species of vegetable and animal is *for ever*, and partakes not of that decay and dissolution, which, at the appointed time, according to the race, brings the individual to the dust. It is for this that the flowers come out upon the plants, that the gleaming lustre of every metal appears on the scales of the fish, that the mammalia and the birds are clothed anew, and that the obscure and crawling caterpillars, awakening from the deep sleep of their pupa state, adorn the Summer air as with living gems and flowers on the wing.

In all that we feel within us, in all that we see around us, we are impressed with the power, the wisdom, and the goodness of Him who made all things, and in making, preserved them; but in this, we behold him as the Eternal, to whom endless duration is one simple and indivisible *now;* and it is this which makes Summer so delightful to the contemplation, and so difficult, so impossible, to be expressed.

But still, though this principle of continuation cannot depart *from* the race, it may perish *in* the race; and, by this means, the balance of the races is always perfect; so that, though there is probably a constant change of the relations of the races, dependent on a progressive state of the planet, as the planet may be dependent on the changes of the more mighty system, they all move in harmony, and as one.

In this the mineral is passive—it knows no Summer, and works for no succession; the plant, rooted in the soil, must abide, and work to the seasons as they come, while the animals escape, or seek shelter; and this is the reason why Summer tells less conspicuously upon the animals. Still, the grand purpose of the season is not the less perfectly accomplished in them, on account of their own energy having a greater share in it, and the mere action of the seasonal stimuli being apparently the less. One circumstance that renders the seasonal display of vegetables more conspicuous, is what may be called the personal action of the plant, in its own individual augmentation of bulk, which precedes, accompanies, or follows the flowering. On the more developed classes of animals, there is no seasonal growth of this kind; for they grow at all seasons, till they attain the size which is proper to their species, under the circumstances. These, of course, have very little difference in the action of the individual life, at any season of the year.

But the humbler classes of living creatures are as conspicuous in their seasonal display as the plants are; and some of them everywhere, and all of them where the extremes of the seasons are great, are even more conspicuous. In winter there is not a single reptile abroad; and in cold places, and during cold weather, there is not one of the invertebrated races to be seen. Where they all go, is a long tale, and this is not the place for telling it. Some are in the earth, some in the waters, some in the substance of plants, and some in the bodies of animals: and they are in all stages of development, from the simple egg, fertilized but not hatched, to the fully matured and perfect animal. Not only this; but, if they were left to themselves, they would remain, in all probability without change, either toward life or toward death, for an indefinite length of time. But the heat of the sun, proving the Divine declaration, that "nothing is hidden" from it, finds them out, and arouses them from their dormancy, in order that they may bear their part in the grand seasonal work of nature.

The times of their appearance differ with their natures, and their numbers vary with the characters of different years,—the law of which has hitherto defied human investigation; but of this we may rest assured, that they always come when the purposes of nature require them, and never till then. The ravages which the seasonal hosts of these minute but innumerable creatures, commit in some years, and at some places, are often great beyond what could be made by the larger animals. Orchard, hedge, copse, every thing, in short, which can produce a leaf, is found stripped to the bare twigs, and these are matted up by the silken webs which the spoilers had constructed as defences for their myriads, against the sun and the rain. The rain-proof quality of these nettings is wonderful; and the same quality appears to be possessed by all webs which animals spin, including those of the spiders, though these are nets for prey rather than tents for shelter. The rain may fall ever so heavy, and the external surface of the tent may be gemmed with little drops like those of dew; but if the colony of caterpillars has been once fairly established, all is dry within the dwelling.

Then the seasonal and local effects of the aphides, on the buds and young stems, are equally wonderful in the irregularity of their attacks, and their numbers and the extent of their depredations when they do make their appearance. Each species, too, keeps to its own kind of plant. The rose aphis never attacks a jasmine, although that and the rose-tree should be intertwined; and the aphis of the cherry-tree never assails the apple. Many of these creatures are so minute, and so obscure in their rudimental state, that no observation can trace them; but it is highly probable that there is not one vegetable, or bud upon a vegetable, whether the product of it is lobe, leaf, or flower, which is not provided with its germ of a destroyer, ready to be developed, if the state of the season should render that development necessary. What the natural necessity for this may be, we are unable positively to say; but we may rest assured that, in every case of those natural attacks, there is a natural justification; and that before nature destroys any production, the purpose of that production is accomplished, or it is incompetent for its office.

Thus, these little animals, which seasonally assail the vegetation, offer an important subject of study, not merely to the naturalist but to the cultivator; for whenever the latter finds that insects destroy his plants, he may rest assured that he has placed them in an improper situation, or that there is something faulty in his mode of treating them.

But though, in all cases of plants being attacked by insects, we may safely conclude that there is something the matter with the plant, it is another and a far more difficult inquiry to find out what that something is, or how it may be remedied. The destruction of the insects themselves can be accomplished only on a small scale; and then it is, at best, a palliative only, not a cure.

There is reason to believe, that there are upon all plants, at the beginning of all seasons of growth, as many germs of small life, as would suffice for consuming the whole produce of that growth, but that, in the case of healthy and well-conditioned ones, these germs are never developed. They are always ready, however, for that particular unhealthy state, whatever it may be, which is favourable to their development, as they are as seasonal as the plants on which they commit their depredations. In wild nature there is no doubt that they contribute to the wholesome working of the system, in which every consumer is really the preserver of the necessary part of that upon which it subsists, by taking away that excess, which, if it were to remain, would impair the quality, and peril the existence of the whole. If all that is produced, or that could be produced of any one species of plant or animal, were to come to perfection, and the process to be continued for even a moderate period of time, there is no doubt that that one species would extirpate all the rest, and ultimately become its own destroyer.

Very many of these seasonal destroyers reside during the winter in the earth. Some commit their depredations on the roots of plants under the surface. These are, generally speaking, the larvæ or grubs of beetles, of which those of the cockchafers and the wire worms are among the greatest pests to the British farmer; and it not unfrequently happens, that when the insects arrive at the last or perfect stage of their varied existence, and are capable of flight, they consume the leaves and other part of plants.

Races which winter in the ground, also come to the surface, and commit their depredations there, often to a very serious extent. One of the most destructive British species of them is the "turnip fly," which, however, is not a fly, but a beetle. This beetle is of very small size, but the multitudes in which it comes, and the rapidity with which it consumes the seed-leaves of the cabbage tribe, more especially the turnip, are but too well known. The danger from this small beetle is confined to a short period of the growth of the plant, as it eats only the seed-leaves, and never touches the rough ones. But there are certain states of the weather in which the plants linger in the seed-leaf; and if they do this, they are almost certain to become the prey of the fly.

Two small flies of the genus *Cecidomyia*, are peculiarly destructive to wheat. One of these, the Hessian fly of America (*C. destructor*), is fortunately unknown in Britain. The females deposit their eggs, from one to eight in number, between the leaf and the stem, at the first joint. The larvæ or grubs are soon hatched, and they continue eating into the substance of the joint, till the stem is so weakened that it breaks off. Spring and autumn are almost equally liable to the ravages of this very small but destructive fly; and no remedy or preventive is known. It seems, however, to be periodical in its ravages, for it is not now so much complained of in America as it was about sixty years ago. The wheat fly, known in Britain, bears some resemblance to the Hessian fly; but it attacks the plant in a different stage of its growth. The parent flies deposit their eggs on the young ears of wheat, just as they are emerging from the sheath. They are placed within the scales that envelop the rudiments of the grain, and the grubs are hatched in about a week. What they eat is not exactly known; but the bloom (*anther*) never appears on the grains which they have attacked, and of course these never make any progress toward maturity. This insect is called the red gum by the farmers; and though, individually, it is so small as to be perfectly insignificant, it sometimes destroys a full third of the crop. This fly, like the preceding one, appears to be periodical in its depredations; but the particular cause of its appearance is not known, neither has any remedy been found.

These are only a mere specimen of the seasonal destroyers of cultivated plants; and it is somewhat humbling to the pride of man, that while he can easily protect his flocks from the wolf, he has no security against enemies of so minute and feeble structure. This shows us, that when we study nature, we must not take individual size or strength as the measure of power, either of good or of evil; for throughout all nature God has chosen "the weak things of the world to confound those that are strong."

Those small animals, which may be said to be every way as seasonal as plants, follow very nearly the same law, in respect of the seasons of different climates, as the plants themselves. Under the equator, and in the tropical climates, they are continual in the places of sufficient humidity to have perpetual growth; and, as the latitude increases, and plants begin to have a winter of repose, these small animals have the same. How it fares with all of them in the winter, we cannot very easily tell, because the greater number are at that time beyond the range of our observation. Very many are in the state of eggs, in which they are, of course, perfectly quiescent. Others are in the larva state; and it is probable that of these some are active and others dormant. Others, again, are in the pupa state, in which they are usually dormant. But there are also many which remain in hiding places during the cold season; while not a few are active, to a certain extent, all the year round. When, however, the progress of the season has prepared their natural food, they fail not to make their appearance. Of winged insects that pass the winter in the last or perfect stage of their existence, it is, generally speaking, the females only that are preserved. In many instances the males resemble the anthers of flowers, by perishing as soon as their purpose for the season is accomplished; and in some of the social races,—the common hive bee for instance,—the males are put to death by the neuters.

In not a few of the species, the Summer labour which the surviving female has to perform is immense. When the warmth of the season calls her from her long slumber, she has first to find a proper place for the future colony of which she is to be the common mother. [We are, of course, supposing that she is one of those bees that can be hatched only in a cell, and of which the races are preserved through the winter, only by a few females that hide themselves from the weather.] The place being chosen—or rather she being directed to the proper place, without any device—she next collects her wax, and builds her cells, feeding freely on the honey of the flowers, and cheering her solitary labours with the music of her wings. When she has finished a cell, she places an egg in it, and also some food for the larva after it is hatched, and closes the cell, but not so as to be air-tight. Other cells are formed in the same manner; and when the young have passed through the three stages of egg, larva, and pupa, they join their mother in the future labours. In some races at least, those races which are first produced are neuters, or workers, and not breeders; but after a certain time males and females are produced, the former all perishing with the season, but the latter escaping, in part at least, to be the foundresses of new colonies in the following season.

The ways in which the principle of life is preserved and developed among those small animals are very various, and some of them are curious in a high degree; but they are all equally demonstrative of that wisdom of design and perfection of execution, which are written in such legible characters upon every production and every operation of nature.

The *aphides*, already alluded to, which are such pests on the roses, peaches, cherries, and other trees, and one species of which sometimes blackens the field beans as if they were scorched by flame, are not the least singular in this part of their economy. In them the fertility of the single egg extends to ten successive generations, all of which perish before the winter, leaving the succession for the next year in the egg, as before. The *aphis rosæ*, which is the most observable of all the *aphides*—as every body that has a bit of ground cultivates a rose-tree, and it is damaged by the depredations of the insect,—deposits its eggs in the autumn, as closely upon the incipient buds of the next year as it can. These eggs are hatched in the spring, contemporaneously with the bursting of the young shoots from the buds. If this takes place very early, and cold weather sets in for a time, though the young shoots are nipped, there is a chance that the *aphides* shall be killed, and that the next budding of the roses will be safe. If this does not happen, the first generation, which are not very numerous, go on growing; and though they do not undergo any transformation, like the majority of insects, they cast their skins twice. After the last casting of the skin, they are mature, and begin to breed; but they are all females, and the young are produced alive, although in a membrane, which keeps each one for some time in connexion with the parent. In this way, there are two generations in spring, and five in Summer,—those which are produced latest casting their skins three or four times; but still being all females, and producing their young alive. Till the skins are cast three times, the animals are without wings; but some winged ones appear in June; and, as the season advances, they all appear winged, the wings being four in number, and large for the size of the body. When they are all winged they are less destructive, or at all events, they live more dispersedly, and upon more matured shoots; so that their depredations are less conspicuous than when the single ones are clustered on the tender shoots. Autumn produces these broods, which are all winged, in the first and second, which are the eighth and ninth of the year, and all females as before. But in September, a tenth generation is produced, consisting of a number of winged males, and a still greater number of wingless females. These also differ from the previous broods of the year, by being not green, but yellow. The males die, and the females continue depositing their eggs till the autumn is considerably advanced ; and then the females die, leaving the eggs to run the same course in the following year.

One of the *aphides*, the "hop fly," *aphis humuli*, is, in a commercial point of view, far more important than the spoiler of the roses, inasmuch as its ravages have been known to reduce the produce of the hop-gardens to *one-thirtieth* of what it is in very favourable years, when "the fly" does not make its appearance. This difference causes, in the bad year, a loss to the public revenue of little less than half a million of pounds, and this by a creature no bigger than a grain of mustard seed! This makes hop-growing a very precarious species of farming; and, like all other matters in which there is a great deal of what is called "chance," it affords considerable scope for the senseless and demoralizing vice of gambling. The cause of the great fluctuations in the hop-fly are not distinctly known; but we believe that they are always least in uniformly dry and very warm Summers—the Summers in which "the fly" is most destructive to turnips.

There is some practical instruction in the aphides, if our limits would admit of our tracing it out. As is the case with most insects which infest plants, if not with all of them, the aphides appear to come to the aid of the plant when it has too much to do—when there are more shoots upon it than it can nourish in a proper manner; and the cure seems to be the instant lopping off, not only of the parts on which the aphis has appeared, but every redundant part, so that the vigour of the plant may be concentrated upon those that are left. The power of vegetation in a plant is a limited quantity; and, if it is distributed over too many parts, its action is feeble in them all. It is of no consequence what is the desired product—shoots, or flowers, or fruit; for, if they are too many, they are always of inferior quality; and very often the artificially treated plant admonishes us when we attempt to work it beyond its strength. For instance, if we allow too much fruit or too much wood on a wall-tree, some parts are sure to die in the course of the season, and these impart to the whole tree disease, which timely and judicious training would have prevented.

Such appears to be the only certain preventive of the mischief which the countless multitudes of these little insects do, when they become formidable to cultivated plants. On a small scale, they may be mechanically removed after they have made their appearance; but in a hop-garden or a bean-field, this cannot be done; and as both of these are annuals in all the above-ground portion, they cannot be pruned as a preventive. This is especially the case in the hop; but the bean suggests a mode of prevention, which, although laborious, is not without its value in another respect. If beans are allowed to "run up" to the full height which they can attain on ground very favourable for them, the flowers on the lower part of the stems prove abortive, as the growth at the top carries away all the nourishment from them; and the aphis really appears to come in mercy, to stop this running up to stem and abortion of flowers. Topping down the plants is the remedy; and where that is done, the aphis, not being wanted, does not make its appearance.

Among the plants in wild nature, the ravages of these insects are by no means so great; because all the parts of wild nature harmonize much better with each other than they do with man's artificial culture. That this must be the case will at once appear, when we recollect that they all work in perfect obedience to laws involved in their own natures, while man works with very imperfect knowledge of the plant which he cultivates, and in great ignorance of its relations to the rest of the system. In a state of nature, there is a regulator appointed to preserve every member within its due limits; and in the case of the aphides, one of the destroyers is a small ichneumon fly, which deposits its eggs in the bodies of the aphides, one in each; and the larva, which is speedily hatched, destroys the aphis. In a state of nature, these checks are sufficient; but when art comes in, it fosters the one race more than the other; the balance is thereby disturbed, and the result is, that the unnatural surplus is an energy without a use, and therefore an instrument of mischief.

We have left ourselves no room to speak of the beauty of the myriads of small winged creatures, which render the Summer air so gay with the brightness of their colours, and show the plenitude of Summer life so much in the liveliness of their motions—the butterflies, the moths, and the Summer beetles; but they are within the range of every one's observation; and any portion of the land—the garden, the field, the dry common, and even the upland waste and the barren sand—may form an ample, an instructive menagerie for the willing student, in the season of the grand nuptials of nature. Even on the summit of Ben Nevis—"the mountain of the heavens," that is, of the sky—where the stones are glued to the earth by frost, even at midsummer, and where the ptarmigan will hardly make its appearance, —in a region, otherwise of desolation and death, we have seen a little butterfly of a dull buff colour, twittering through the air; and, over the summits of some of the most lofty mountains on the European continent, the adventurous traveller has observed the eagle breasting the wind, still higher above him, and, of course, with telescopic eye scanning the earth below, in quest of prey to carry to the ever-craving eaglets in her eyrie on the cliff:—so full is nature at this time of subjects for our excitement and our information, and each one more inviting and instructive than another.

The reptile tribes, which form so large a chapter in the natural history of the ardent climates, and which are there so formidable in the larger crushing serpents, the more deadly poisoning ones, and the great *sauria*, —the crocodiles and the alligators,—so curious in their land tortoises, and so valuable in their sea turtles, for the flesh and the eggs, as wholesome and abundant food, as in the case of the green turtle, or for the plates of their curiously constructed buckler of defence, as in the hawksbill,—and so lively with the smaller *sauria* of the land, displaying, in the most irregular forms, every colour and every lustre that imagination can picture, and far more than tongue can name;—these tribes are, with us, few and uninteresting. Of *sauria* we have but one species, the nimble lizard; and it is not common, though there are probably several varieties of it. But where we " open the monument," and look what has been in former times, we find the bones of giants, some of which must have been forty feet in length, but of which there is no living specimen now to be found, or has been since man began to record the history of animals.

Three *Ophidian* reptiles, with probably varieties of some of them, are all of the serpent order that our islands contain. These are perfectly harmless, except the viper, and even it does not seek, but must be sought for. *Batrachia* are more numerous, and some of them are far more common; but all of them are perfectly simple and harmless creatures; and, with the exception of the common frog, they are but rarely seen. With the exception of the land eft, which is found under rubbish, and in damp and shady places, of which the mode of production is not very well known, all the rest are produced from eggs, and pass the first stage of their existence in the water, breathing through the medium of that liquid by means of gills. There are various popular prejudices against these obscure and simple creatures,—such as that some of them are poisonous, and that others find their way into the stomachs of human beings, and live there, to the great annoyance of the parties; and we must confess, that wherever the belief of an occupation of this kind gets possession of the mind, it is quite incurable, as the occurrence is not only unlikely, but physically impossible, as none of the batrachian reptiles of this country can live in a temperature so warm as that of the interior of the human body, even in its natural and healthy state. There is an anecdote told of the late highly-talented but somewhat eccentric John Abernethy, which, whether correct in the imputation to him or not, is an admirable satire on those foolish fancies with the belief of which weak persons are sometimes self-tormented even at the present day. A lady was fully impressed with the belief that she had swallowed a spider, and that the said spider was carrying on its operations in her interior, much in the same way as though it had been in the corner of a neglected apartment. The belief tormented her, and she applied to Abernethy to use his art for ejecting the unpleasant occupant. "Are you certain that the spider is there, madam?" "Quite certain, sir; I can feel it moving about." "Moving about, eh! madam, that's well. Go home, catch a blue-bottle fly, enclose him in your mouth, and make him buzz; the spider will be at him in an instant, and then, you know, you can easily spit them both out together."

Reptiles inhabiting the land or the fresh waters of temperate countries, are the most seasonal of all the vertebrated animals. None of the British ones can bear the open air in the winter, and they generally cannot bear the direct heat of the Summer sun. But they have great powers of endurance of another kind: they can exist without food for a long time,—some of them for years,—without any wasting away of their substance. They are not destitute of discernment, and some of them, as, for example, the lizard and the common toad, are very easily tamed, at least so far as that they will come when called. They are not very characteristic animals, however; and thus, though very strictly Summer ones, they have but little interest except to naturalists.

Upon the vertebrated animals that have warm blood —the mammalia and birds—the seasons have much less influence; and, generally speaking, their movements are more in search of food than for change of temperature.

In Britain, the wild mammalia,—whether in a persecuted state, as is the case with the predatory ones, or in a state of partial and seasonal protection, as is the case with those called game,—are not very numerous; they hardly make a feature in any landscape; and they are, besides, not very seasonal. In the Summer, the few predatory ones are usually dispersed, and, as they are almost all night or twilight feeders, they are not often seen. The game mammalia, of which the hare family and the few wild deer that are still left are the chief, have their young in the beginning of the season, earlier or later according to circumstances; and after this they have the annual change of their hair and fur,—the deer shedding their horns along with the old coat. Both these operations tend to weaken them, and deteriorate the quality of their flesh,—the law of nature and the policy of man, which are not always in unison, agreeing, in this particular case, to allow the animals to enjoy the Summer without *legal* violence at the hands of men. Other than what have been mentioned, there are not many seasonal displays among the wild mammalia of Britain. Their new coats are of course more smooth and glossy than their old ones; and when the animals are seen, they are seen to greater advantage; but although the coats of all of them are a little bleached or weather-beaten before they are shed, there is only one which undergoes a decided change of colour. That one is the alpine hare, which inhabits the lofty mountains only, and never descends into the valleys, even in the most inclement season. In winter it is spotless as the driven snow; but after the change of fur in the Summer, it is bright-yellowish fawn on the upper part, passing gradually into white on the under, and having the dark part finely dappled with perfectly circular spots of white. In this state it is really a very beautiful animal; but it is one which is but seldom seen; for, though rather larger than the common hare, and not so timid, it is very local, and rare in its localities. The Summer is the only time when an ordinary visitor,—even one who has nerve and limb sufficient for enabling him to add a day to his enjoyment, and a year to his life, by climbing the mountain,—can see the alpine hare in its own locality; and he will have a chance of meeting also with the ptarmigan, which has a similar change in its plumage as the hare has in the fur; but it inhabits at still greater elevations. In those wild and lonely places, where none of the ordinary voices of the earth reach the ear,—not even the bleating of a mountain sheep,—and, save the moaning of the wind, the roll of the thunder, told twenty times over in the echoes of the precipices, or haply the occasional "cherrup" of the eagle, which nestles here to have the command of the whole wilderness, and "the sky" of every kind of prey, there is not a sound;—in those places, the few animals that are to be met with, claim kindred with the visitor; and, on the very extremest bourne of terrestrial life, they, as it were, render themselves up to man. If you happen to meet a family of ptarmigan, and throw a stone, so that it alights beyond them, they will run close to your feet, and you may all but catch them in your hand. Some have, on this account, set them down as "stupid" birds; but the epithet is misapplied, for they are only adapted to places very different from those with which mankind are familiar, and their natural enemies are very few.

The ptarmigan naturally call our attention to the other birds, of which the seasonal displays are much more striking than those of our wild mammalia. But though the birds are more seasonal than the mammalia, it by no means follows that they are less hardy. Their labours are more severe than those of any other class of animals; and as, throughout the whole of nature, the provision is always in exact proportion to the necessity that there is for it, we must conclude that they are the most hardy of the whole. But their hardihood is active, not passive like the simple endurance of those reptiles which doze out the greater part of their time in perfect inactivity, or those mammalia which are dormant during the winter. Birds are creatures of the free air of heaven, breathing not merely by their lungs, as all other air animals breathe, but by the coats of very many of their blood-vessels, and having air-cells in the substance of their very bones. They have also a quicker circulation and a higher temperature than any other animal; and as their system works more, it must wear more, and consequently require a more abundant supply of food. The feathers of birds, too, are an additional drain upon them; for though mammalia cast and renew their hair much in the same way that birds moult their feathers, the feathers have a double function to perform, while the covering of the mammalia performs only a single one. The hair or fur is merely clothing, suited for the protection of the animal against the temperature, and the variations of temperature to which it is exposed, and nothing more; but the feathers on the bird are organs of motion, as well as a protection against the weather. They have to bear up the weight of the animal when it flies, and also to carry it onward with a rapidity far exceeding that of any of the mammalia. A few hours' motion, at the rate of ten or fifteen miles in the hour, completely fatigues a horse, even though trained for the purpose by the utmost art of the jockey; but a swift can spend sixteen hours on the wing every day, and fly the whole time at the rate of not less than fifty miles in the hour; so that its ordinary day's excursion in pursuit of its prey is not less than eight hundred miles. This being the case upon the ordinary feeding stations of the bird, as, for example, with us during its annual sojourn in the Summer, we can readily believe that, when it is under a particular impulse, as when journeying northward in spring, or southward in autumn, it may pass over fifteen hundred or even two thousand miles upon a stretch, and in little more than the length of one single day of twenty-four hours.

This great power of motion which the birds possess, enables them to perform offices in the economy of nature, which no other animal can perform. Where the climate is very seasonal, the resident animals that are equally so, are in the egg, or dormant during the winter; but they come out in multitudes during the Summer, because there is then much for them to consume. It is a law in the whole system of nature, that every race of beings which are numerous as consumers, is equally fertile in furnishing a supply to other races. For this reason, all the polar and the upland places, which have life in a great measure suspended in the cold season, but very active in the warm, have ample stores for Summer birds, not one of which can find its food there in winter. This surplus is, considered as food, adapted for birds only, as it is placed in situations where the greater part of it cannot be reached by mammalia, by reptiles, or by fishes; and as mammalia and reptiles are not capable of leaving the northern and upland places when their food fails, there are comparatively few of them in such places; and of the mammalia none are extensively feeders on insects and the other small animals which are to be had only in the Summer.

It is this which occasions the movements of the migratory birds toward the cold latitudes, the dispersion of the resident ones over the country, and the congregating of the sea-birds upon the cliffs. Each gives place to some other species in the place which it leaves, and each finds, in the place which it visits, a store which would otherwise be lost; and while, by these means, the purposes of nature are accomplished in the most perfect and beautiful manner, the interest of the Summer to man is greatly augmented.

At this delightful season, he finds those winged inhabitants in a state of activity, and rearing, with great labour, the birds of future years, in every situation, from the far sea-rock to the summit of the mountain. In many places of the former, the foot can hardly be planted without breaking an egg, the sun is clouded with wings, and the ear is stunned by the mingled sounds of screaming voices. One pinnacle is white with gannets; upon another, the dark cormorant, just returned from the water with a load of fish for his mate, is drying his dark wings in the sun; and in the rifted precipice, which the elements have worn into holes, there are countless myriads of petrels and other birds which, during the other seasons of the year, fly devious over the expanse of the ocean: and again, when their necessities require, these birds are ranging the beach, or skimming the surface of the waters, or driving through the mass of the water like arrows, but all occupied, and all abundantly fed.

As we recede inland, the species are different, and the numbers diminish; but, in the Summer, no place is without its bird, and no bird is without interest, both as it appears, and as it discharges its duty in the grand system of nature. It is a pleasing task to visit them in their haunts, and to know them all: but our measure is full, and we can only recommend them to the reader, as a means of being impressed with the perfection of Nature, and the wisdom and goodness of its Almighty Author.

Yet one word more, before we take leave of this delightful season—before we say,—

> "Farewell! the bright day, thou green earth, and ye skies,
> Now gay with the warm Summer's sun."

For there is a general lesson arising from the Summer, which breathes of immortal life, even as the Summer itself, in its most beautiful but most mysterious operation, secures the flowers, and all the seasonal productions of nature, in their regular succession, till that awful but unnumbered day, when the mighty angel shall come down from heaven, clothed with a cloud; and a rainbow upon his head, and his face as it were the sun, and his feet as pillars of fire; and shall set his right foot upon the sea, and his left foot upon the earth; and with a loud voice, as when a lion roareth, shall swear by Him that liveth for ever and ever, who created the heavens, and the things that therein are, and the earth, and the things that therein are, and the sea, and the things that are therein, that THERE SHALL BE TIME NO LONGER. Even in the very excess of nature's beauty—in the moment at which it works for the sure continuation of the race, the destroying angel passes over the individual; and, its purpose being accomplished, its death is begun. But though the flower fades, and fades the sooner the more perfectly its work is done, the germ is safe in the keeping of Him who is the Lord of both flower and gem. It is even so with us: every moment that we live, every breath that we draw, every action that we perform, brings us nearer to the time when the body shall be rendered up to the common store of matter, and the spirit, clothed in the garment of immortality, shall stand before the throne of its God. Let us, therefore, emulate the flower; and pass from this transitory world full of knowledge, of good works, and of charity, and taking strong hold on immortality, through faith in the atoning blood of the Redeemer.

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